

Thesis/
Reports
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An Analysis of the Flora of the Canadian
River Canyon, Mills Canyon Section

by William Martin, Reggie Fletcher,
and Paul Knight

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AN ANALYSIS OF THE FLORA OF
THE CANADIAN RIVER CANYON
MILLS CANYON SECTION

BY

William Martin
Reggie Fletcher
Paul Knight

TO

U. S. Forest Service
Range Management Division
November 15, 1981

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EXPERIMENT STATION

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An Analysis of the Flora of
the Canadian River Canyon
Mills Canyon Section

Introduction

The U. S. Forest Service management division of the Canadian River Canyon--Mills Canyon area, is a part of the Kiowa National Grassland (Panhandle National Grasslands) and is located in Harding and Mora counties, northeastern New Mexico, more specifically about 30 miles east-northeast of Wagon Mound. The Canadian River Canyon is the most spectacular topographic feature in the prairie country of northeastern New Mexico.

This report concerns a vegetational study of approximately 50 sections of rangeland, canyonland, and floodplain west of State Highway 39. The study area extends for a distance of about six miles westward to the mesas west of the Canadian River Canyon and from a point approximately four miles north of Mills to the vicinity of Roy, about 14 miles to the south.

The study area encompasses large expanses of upland rangeland, most of it heavily grazed, numerous steep rocky slopes, the main stretch of the Canadian River Canyon, and a number of precipitous side canyons, many of them several hundred feet deep. The majority of all the bedrock in the study area is sandstone but a fragmented caprock of limestone overlies the sandstone in a band running roughly north to south a short distance west of State Highway 39.

The study involved two periods of collection and observation. The first field period occurred between June 30 and July 4, 1981 and was staffed by a volunteer field crew of mostly experienced field botanists. These personnel represented the University of New Mexico, New Mexico State University, the U. S. Forest Service, the New Mexico State Heritage Program, and the Los Angeles County Museum of Natural History and included William Martin, Reggie Fletcher, Paul Knight, Richard Spellenberg, R. Soreng, D. Ward, Beth Schmidt, Ann Cully, Mollie Toll, Sandra Limerick, Tim Fischer, Robert Gustafson, Pamela Fletcher, and Gwendolyn Fletcher, Chris Knight, Rex Wahl, and Elizabeth McLellan. The second phase of this study occurred later,

on September 17 and 18, 1981, when the area was again surveyed for floristic data, this time by William Martin and Reggie Fletcher.

We were convinced that two phases of study were necessary because of the drought conditions prevailing in the area until midsummer, 1981. The flora was relatively sparse during the early part of the growing season. The greatest variety of species occurred in protected habitats, such as in narrow canyons and along watercourses. Abundant mid- and late summer rains (more than 20 inches in less than two months) resulted in an explosive growth of vegetation late in the growing season. This development made necessary the second survey in September to make additional collections from selected parts of the study area.

During both surveys, more than 1000 collections were made from numerous habitats. These collections represented 493 taxa arranged in 73 families of ferns, fern allies, gymnosperms, and angiosperms.

Initially, the study area selected was to include that portion of the Canadian River drainage lying within the boundaries of the Kiowa grasslands. Teams were to survey and collect plants specimens from both rims of the canyon, the canyon bottom, and as many of the small tributaries as possible with the time and manpower available.

The discovery of Astragalus wittmannii, a candidate for Federal protection, by the NMSU crew on their way into base camp necessitated enlarging the study area to include the limestone knolls and caps northward to a point just north of Abbott Lake and southward to the vicinity of Roy. Mapping and intensive collection of the enlarged section was not possible due to time constraints.

The first week in July was selected for the field session after checking historical rainfall patterns for the Grasslands. It was felt that if we had to confine our investigations to a one-time effort, this time period would allow us to include some of the holdovers from the spring flora as well as some of the early fall-flowering species. The severe drought greatly

affected the number of taxa present and to some extent the flowering times, thus we were unable to collect as many plants of either category that we had anticipated, but the time selected was still the best compromise possible.

The study area was ideally situated to provide an interesting mixture of prairie and montane species. We had hoped to detect differences in local species distribution and perhaps locate habitats favoring one group over another. However, two conditions, drought and grazing, worked together to mask geographical relationships.

Long term intensive grazing has greatly reduced species diversity in all but the more inaccessible habitats. This reduction to relatively few species well adapted to present climatic conditions and grazing intensities probably modifies geographic relationships that might have been evident with a more pristine flora. The survey was also conducted during an intense drought. In many places the grass was fully utilized and was so badly burnt that livestock could no longer obtain a bite of grass without damaging the root crown. In spite of intensive field searches, the drought undoubtedly detracted from the reliability of our distribution data. For example, Aster horridus was found in only three locations in July but was common in September after the rains.

After the second field day, it was agreed that it would be more efficient to concentrate on as complete a general survey of the area as possible and to reduce emphasis on transect data and other numerical values for use in comparative studies.

Although a very important segment of this report constitutes the annotated checklist of plant taxa and the common-name list of animals sighted, a vegetation map is included to show the dominant makeup of the various geographic and topographic locations. In addition, general descriptions of various of the small canyons and other areas collected are provided to further familiarize the reader with the study area.

Vercere Canyon

Vercere Canyon is a small tributary (in Secs. 21 and 22,

T21N,R24E) oriented from east to west and emptying into the Canadian River about 1/4 mile below Mills Forest Camp. The mouth of the canyon lies at about 5200 ft elevation. This canyon was sampled from its mouth to a point near its head at about 5900 ft elevation. Vercere Canyon was collected on June 29 by Paul Knight and Reggie Fletcher; Reggie worked the bottom of the canyon while Paul surveyed the middle and upper slopes.

The mouth of Vercere Canyon is dominated by Pinus edulis and Juniperus monosperma in an approximate 1:1 ratio. The pinyons produced a moderate fall crop of nuts despite the severe drought. A few of the Ipomoea leptophylla, so common in the sandy areas along the river, occur above the floodplain and near the mouth of the canyon. More common taxa include Bouteloua gracilis, B. curtipendula, Hilaria jamesii, Andropogon scoparius, A. saccharoides, Gutierrezia sarothrae, Rhus trilobata, Quercus undulata, Quercus grisea, and Opuntia imbricata. Artemisia filifolia was occasionally seen and Eurotia lanata and Artemisia frigida were noted rarely.

Physiographically, Vercere Canyon is composed of steep reddish sandstone sides and sandstone scarps of various sizes rimming the canyon.

The floor of the lower canyon contains Tamarisk pentandra, Salix exigua, Fallugia paradoxa, and Melilotus albus. Rhus radicans and Parthenocissus inserta, common in the narrow rugged tributaries of the Canadian River drainage, are rare near the mouth of Vercere Canyon but become increasingly common as one proceeds farther into the canyon.

The exposed south-facing slope has few Pinus edulis compared with the dominant Juniperus monosperma. Dalea formosa, Echinocereus triglochidiatus, Fallugia paradoxa, Rhus trilobata, and Cercocarpus montanus are also here. The north-facing slope is dominated by Quercus undulata. Some 600 yards up the canyon beyond the mouth are stands of Juniperus scopulorum and Pinus ponderosa. Beyond this point, the canyon floor steepens to about 10° with an average of 30° for the sides. Quercus undulata is now found on both walls and J. scopulorum occurs in increasing abundance.

At the border of Secs. 21 and 22, Populus X acuminata occurs with Amorpha canescens and Verbascum; ponderosa pine also is found here but is uncommon. The canyon floor now becomes strewn with large boulders, some of them several feet in diameter. On the south-facing slope oaks dominate but Bouteloua eriopoda and Prosopis glandulosa were also encountered. In the upper reaches of the canyon, the larger trees have been logged on the north slope and along the rims.

The woodland area on the east side of the Canadian River Canyon is more or less confined to the vicinity of the canyon rim in contrast to that of the west side which forms a wide border more typical of a pinyon-juniper community. The rim on the west side is, however, slightly higher than is that of the east side. The rim above Vercere Canyon is bordered by an often bare sandstone cap. Ponderosa pine, heavily cut over in the past, forms a scrubby forest in this shallow soil. These trees owe their existence to moisture accumulation in the cracks in the sandstone. As one proceeds in all directions away from the rim, the oaks diminish in importance as soil depths increase and share dominance with pinyon-juniper vegetation. Also, blue grama dominates along with Buchloe dactyloides Muhlenbergia torreyi, Hilaria jamesii, the latter varying in amounts according to intensity of pasturage.

Biscante Canyon

Biscante Canyon is located in Secs. 21 and 22, T22N, R24E, and is oriented from northeast to southwest. The head of this canyon gently slides into a multitude of tiny fingerlike canyons that disappear into the dry plains. The plains are represented by open grasslands characterized by scattered Yucca glauca and J. monosperma. The grassland is interspersed by stands of Gutierrezia, indicating the impact of centuries of overgrazing.

At the head of the canyon, one drops into a shallow depression marked by concentrations of P. edulis. Here the soil is compact and sandy, derived from a white, fractured, easily erodable sandstone. The most common species here are Chenopodium album, Melampodium leucanthum, Hymenoxys acaulis, Gaura

coccinea, Portulaca oleracea, Solanum rostratum, Pinus edulis, and Gutierrezia sarothrae.

As one continues into the canyon, it turns into a narrow, gently sloping gorge, cutting through sandstone at about a 4-6° dip. To our delight, we began to encounter permanent marshes carved into the floor of the sandstone canyon. The dominant species within the canyon included Rhus trilobata, Quercus undulata, Opuntia imbricata, Juniperus monosperma, and Brickellia californica. In the pools and marshes we found Sagittaria cuneata and species of Juncus, Carex, and Oxalis. Ferns were very common in the sandstone ledges above the pools. One large pool measuring about 20 ft wide, 40 ft long, and 10 ft deep was populated by sunfish.

As one continues down the canyon, alluvial deposits begin to cover the canyon floor, and the water which is so prominent in the upper canyon, sinks beneath the sandy surface of the deposits of the lower canyon. Here willows and the canyon grape (Vitis arizonica) abound. The hillsides are characterized by stands of Rhus trilobata, Pinus ponderosa, Pinus edulis, Juniperus monosperma, J. scopulorum, Vitis arizonica, and occasionally Cucurbita foetidissima. On the drier slopes cacti, especially Echinocereus triglochidiatus, abound.

Deeper in the canyon, forest elements become more prevalent. Huge ponderosa pines and spreading pinyons form a canopy. At a point about 3/4 mile down the canyon, we located abundant stands of Tradescantia, Melilotus, Amorpha, Tragopogon, and Verbascum in the deep soils. At this point, the forest retreats to the canyon floor. Sandstone parapets dominate the upper slopes as the canyon widens and becomes drier. The canyon bottom still exhibits some evidence of subterranean moisture but standing water is not to be found.

About a mile down the canyon, we encountered large narrow-leaf cottonwoods. At this location, patches of ungrazed grasses dotted the rocky hillsides; these grasses primarily belonged to the genera Panicum, Sporobolus, and Bouteloua.

About a mile from the mouth of Biscante Canyon, the main channel merges with a large northern branch, the combined canyons opening up to form a very wide and dry west-draining canyon. The south-facing slope of this canyon was extremely arid. Here the upper slopes were of parched red sandstone, with the lower slopes composed of a soft, somewhat rotten white sandstone. There were few pinyons on this slope and the scattered junipers were dwarfed and gnarled.

The north-facing slopes were decidedly more mesic than the south-facing slopes and the hillside was dotted with an abundance of Pinus edulis and Juniperus scopulorum. In addition, there was a good cover of Bouteloua gracilis and Hilaria jamesii all along this slope.

Casa Chiquita Canyon

Casa Chiquita Canyon (Sec. 28, T22R,R24E) is relatively small and east-west oriented. From the point of its intersection with the Canadian River Canyon in Sec. 28, it climbs steeply to the plains above. Because this canyon is relatively narrow, deep, and short, the vegetation tends to be rather homogeneous. The upper slopes were found to be dominated by Juniperus monosperma, Pinus edulis, Nolina microcarpa, and Opuntia imbricata. The lower canyon, which is sharply flanked by steep cliffs, contained Pinus ponderosa, P. edulis, Quercus gambelii, Forestiera neomexicana, and Populus angustifolia.

Free-standing water was absent in the canyon and a riparian flora, so common in Biscante Canyon, was not in evidence. We were unable to locate any taxa different from those characteristic of Biscante Canyon.

Above Casa Chiquita Canyon, where the drainage from the plains cuts through the sandstone bedrock, several small pools are formed. In this area, the dominant vegetation was found to be Pinus edulis, Juniperus monosperma, Opuntia imbricata, Echinocereus triglochidiatus, and Forestiera neomexicana. The pools are apparently intermittent and contained only a few pockets of sedges, none with mature spikes.

Blanco Canyon

Blanco Canyon is located at the southern end of the Forest Service boundary corresponding to the southern limits of the study area (Secs. 15,21,22,28, T20N, R25E). The canyon drains first from north to south and then toward the west. At the head of the canyon, one encounters a gentle gradient which passes over broad areas of pocketed sandstone. Here numerous cenotelike pools have formed. The surrounding vegetation included Pinus ponderosa, P. edulis, Juniperus monosperma, Opuntia imbricata, and Yucca glauca.

A short distance from the head of the canyon, some industrious rancher has constructed an impressive dam of stone and concrete. The vegetation surrounding this impoundment was Polygonum aviculare, Portulaca oleracea, Verbascum thapsis, Chenopodium album, and Melampodium leucanthum. The surrounding rocky slopes were characterized by Opuntia imbricata, O. phaeacantha, and O. polyacantha. The area, as indicated by the vegetative indicators of disturbance, appears to be heavily overgrazed, past and present.

At a point about a half mile below the dam, Blanco Canyon widens, juncturing with a larger, relatively mesic canyon which drains in from the east. The dominant vegetation at this point included Pinus ponderosa, Populus angustifolia, Quercus grisea, Juniperus monosperma, J. scopulorum, Ribes montigenum, Brickellia californica, and Bouteloua curtipendula. The floor of the canyon supported stands of Sisyrinchium, Carex, Juncus, Lathyrus, and Equisetum. Further down the canyon, large boulders and sharp dropoffs were encountered. Although we found no free standing water at this point, we could easily, despite the drought, find water below the surface of the sand by digging in the bottom of the dry pools adjacent to these boulders. In this general area, we encountered large stands of twining wild grapes (Vitis); some of these vines reached considerable size.

About a half mile down the canyon from the previous collection area, we noted a change in species diversity among the forbs but very little change in the dominant vegetation.

At this point we made collections of Melilotus alba, Psoralea spp., Chicorium intybus, and Echinocereus triglochidiatus var. neomexicanus. Just beyond this point, we began to notice a change in the morphology of the oaks. For example, we noticed that the Quercus gambelii was very atypical, showing genetic influence of other oak species, even a suggestion of features like those of the eastern red oak. This is highly unlikely, however, because of the strong genetic barriers existing between the white oak and black oak subgenera.

About 1.5 miles downstream from the juncture of the two canyons, we noticed a decided change in the relative humidity level of the canyon and as the canyon broadened, the ponderosa pine phased out and species of juniper began to appear. At this point, we travelled diagonally to the northwest across the south-facing slope of the canyon. The only plant of interest encountered in this side trip was a small truncate Mammalaria with the apex only slightly above ground level. Our initial reaction was that this was probably a species called M. gummifera or perhaps a variety of M. heyderi. Without flowers and/or fruit, definted identification was not possible. We then angled back to the northeast and skirted the top of the canyon. Vegetation of significance included overgrazed grassland dominated by a carpet of snake-weed and dotted with patches of Yucca.

Mestenito Canyon

Mestenito Canyon (Secs. 2,11,35, T21N, R24E) is roughly "T"-shaped, with the top of the "T" longer than the stem and running from north to south. The stem of the "T" is not only shorter but also drier and runs from east to west. Mestenito Canyon is impressive with the upper area composed of red sandstone and the lower slopes composed of sculptured white sandstone. The top of the canyon is dominated by Juniperus monosperma, Rhus trilobata, Quercus undulata, and Cercocarpus montanus.

We began the exploration phase by walking from west to

east from the mouth of the main canyon toward its head. To our delight, we encountered a torrent of water rushing down the canyon. The lower canyon was very mesic and featured large stands of Pinus ponderosa. Here, the slopes were strewn with large boulders covered with numerous lichens and many boulders provided a suitable habitat for extensive populations of Cheilanthes villosa. The secondary dominants were Quercus gambelii, Ptelea trifoliata, Pinus edulis, Juniperus scopulorum, and Rhus trilobata. Adjacent to the stream were significant stands of Urtica, Vicia, and Helianthus.

The upper slopes of this canyon were more xeric and were dominated by Quercus, Cercocarpus, Echinocereus viridiflorus, E. triglochidiatus var. melanocanthus, Opuntia imbricata, and Coryphantha vivipara. Further up the canyon, numerous boulders and ledges were encountered. Plantlife here included Hilaria jamesii, Bouteloua curtipendula, Brickellia californica, Cheilanthes villosa, Woodsia spp., and Solidago wrightii. The mid-slopes at this point were characterized by ponderosa and pinyon pines, Ribes spp., Rhus toxicodendron, Bromus, Andropogon, Quercus, and Parthenocissus insertus. The north-facing slope below the rim featured stands of grasses including the genera Andropogon, Sporobolus, Hilaria, and Aristida.

The upper reaches of the canyon were characterized by a definite drying trend, primarily because the canyon had become relatively shallow, no longer providing the sheltered effect typically afforded by a deep narrow canyon. The north-facing slope was vegetated by Pinus ponderosa, Rhus trilobata, Pinus edulis, scattered Penstemon barbatus, and species of Quercus. This associated prevailed down the slope to stream-side where Vitis arizonica, Brickellia californica, Melilotus alba, Rumex spp., Verbascum thapsus, Bouteloua curtipendula, Equisetum, Cyperus, Juncus, and an occasional Tamarix occurred. On the south-facing slope were Pinus edulis, Opuntia imbricata, Yucca baccata, and species of Quercus.

At this point, we left the east-west dogleg of Mestenito Canyon and proceeded northwest to intersect with the head of the main canyon which runs approximately north to south. The interceding area between the two canyons was open grassland, heavily overgrazed. At this juncture, we encountered a wild burro moving off into the canyon. We also noted numerous plants of Mammillaria at the margins of the grassland. The head of the north-south drainage of Mestenito Canyon was densely populated by Prunus virginiana, Pinus edulis, Rhus trilobata, Cercocarpus montanus, Bouteloua gracilis, Hilaria jamesii, Brickellia californica, Portulaca oleracea, and Chenopodium album. Also, scattered stands of Opuntia phaeacantha, O. polyacantha, Gutierrezia sarothrae, Buchloe dactyloides, and Artemisia frigida occurred.

Proceeding southward into the canyon proper, we began to encounter mesic areas. Here were Verbascum thapsus, Bouteloua curtipendula, Rhus toxicodendron, Melilotus alba, Scirpus spp., Juncus spp., Phragmites communis, Woodsia spp., Vitis arizonica, Sagittaria cuneata, Taraxacum officinale, and Equisetum.

About a third of a mile further down the canyon, we found a large spring emerging from the east-facing wall. Although the spring appeared from sandstone, the water was highly calcareous, suggesting that the water must have passed through a limestone deposit previous to passing through the sandstone. Rate of flow was about a half gallon per minute. A large population of the orchid Epipactus giganteus was growing in overflow of the spring. There were between 50 and 100 plants in this population, most of them in flower but some of them in fruit. This same species of orchid was also located about 200 yards further down the canyon, growing beneath a ledge.

The upper canyon area is fairly mesic, the channel cut through white sandstone. The surrounding hillsides are primarily parkland with the slopes dotted by Pinus ponderosa and Juniperus scopulorum. Also found were stands of Pinus edulis, Cercocarpus montanus, Rhus trilobata, Vitis arizonica,

Parthenocissus inserta, and Quercus undulata.

Along the stream, an abundance of Salix spp. and Franseria acanthicarpa were discovered along with Acer negundo, Ptelea trifoliolata, and Equisetum spp. About one-half to two-thirds of a mile down the canyon, the sandstone cliffs become dissected to form numerous broken ledges and rock shelters. At one point there is a sharp drop of at least 25 feet to the canyon floor resulting in a waterfall and large natural amphitheater cut into the sandstone. Here we noted a herd of approximately 40 Barbary sheep. Below this point, the canyon drops steeply and is littered with massive boulders, often 20 feet in diameter. The water disappears beneath the surface. No new species were encountered here. The lower canyon levels out and has intermittent pools of water. Here we located extensive stands of Acer negundo, Salix spp., and Populus angustifolia.

Spring and Small Unnamed Tributary

Due East of

Mills Canyon Campground

The upper more rugged portion of this south-southeast-flowing canyon, primarily that portion lying with Sec. 14, T21N, R24E, was surveyed by Reggie Fletcher, Ann Cully, and Tim Fischer on Tuesday, June 30, 1981.

The head of the canyon boxes up with the runoff and the overflow from a small spring forming pools and seeps that provide a large variety of riparian species. Most of the species noted in this canyon were restricted to or at least found within the boundaries of the mesic upper one-fourth mile of the canyon.

Except for a small outcrop of shale, the canyon is composed of sandstone rimmed by a narrow scarp. The canyon sides and floor are steep. The east-facing slope averages some 30°, the west slope about 20°, and the bottom approximately 10° with some spots as much as 20°. The canyon floor is strewn with car- and room-sized boulders. At the border of sections 14 and 23 the canyon rim opens to the main canyon and the small tributary drops sharply to the floodplain below.

On the steep east slope the dominant plant is Juniperus monosperma. Pinus ponderosa is occasional and scattered Yucca baccata, Nolina microcarpa, and Quercus undulata occur. The more shaded western slope is mostly Juniperus scopulorum and Pinus ponderosa. The overstory on the rim above the box is a mixture of J. monosperma, Q. undulata, and Pinus edulis.

In the small box of the canyon just below the spring area are such overstory plants as P. ponderosa, Salix exigua, Salix amygdaloides, Populus fremontii, Populus X acuminata, and J. scopulorum. Forestiera neomexicana is common along the canyon floor as it was in all of the steep narrow canyons surveyed. The rugged nature of these small canyons has protected these species from livestock use and, while stock use a dozed trail into the water at the head of this canyon, the remainder provides a practically inaccessible habitat for the more sought-after species. The boulder-strewn floor provides only a small amount of level area, nonetheless, the variety of taxa afforded by the multitude of microhabitats is surprising.

The complexity of hybridization of the oaks within the study area was as difficult to decipher as in any area the participants could remember. In this canyon alone, specimens showing traits of and possible crossing with Q. rugosa, Q. havardii, Q. gambelii, Q. undulata, Q. grisea, and Q. pungens were noted.

East Rim (W 1/2 Sec. 23, E 1/2 Sec. 24, T21N, R24E)

After collecting the spring and canyon area in section 14, Fletcher, Cully, and Fischer crossed up and out of the canyon to the east rim of the Canadian River Canyon, proceeding southward to the small rugged canyon in the east 1/2 of section 25.

Near the rim, Bouteloua gracilis dominates with some Hilaria jamesii, an occasional plant of Aristida spp., a rare Pinus edulis and Opuntia imbricata, and patches of Quercus undulata and Juniperus monosperma. This area is composed mostly of open grassland except adjacent to the rim where the oak-woodland association is more typical.

As one proceeds eastward from the rim, prairie influences increase and woodland influences decrease. Bouteloua gracilis

dominates but with Opuntia imbricata, Muhlenbergia torreyi, and Buchloe dactyloides increasing according to intensity of past use. Buchloe dactyloides is the last grass to go out and the first to come back in areas heavily impacted, such as cattle trails. Local diversity includes such species as Eriogonum jamesii, Cryptantha jamesii, Haplopappus spinulosus, Solanum elaeagnifolium, Thelesperma megapotamicum, Artemisia frigida, Gutierrezia sarothrae (most of which appeared dead due to drought stress), Opuntia polyacantha, Engelmannia pinnatifida, and Psoralea tenuiflora.

At a dry stock pond in the bottom center of section 24, the weedier species typical of the area were encountered including Euphorbia marginata, Solanum rostratum, Verbena plicata, Helianthus annuus, and Xanthium strumarium. However, one weed present is worthy of special attention. Suckleya suckleyana (poison suckleya) was abundant in the bottom of the dry tank. This plant is poisonous to livestock by reason of its potential for producing hydrocyanic acid. At times cattle losses in Colorado and New Mexico, due to this plant, have been heavy. Poison suckleya is found in moist sink holes and around the drying borders of lakes and ponds and in tanks such as the one in which it was found. Because this species is an annual, it is difficult to control except by complete removal of the seed source. It is one of the few undesirable plants localized enough in occurrence to merit attention in this report. Although in some instances, it appears this plant has actually been sought after by livestock, the better the condition of the range, the less likely are the chances of Suckleya causing problems.

Even with drought conditions making things look worse, this pasture was one of the worst according to species composition. In other pastures along the east rim, grasses in the September survey showed a mixture of Bouteloua hirsuta, B. gracilis, Andropogon saccharoides, Hilaria jamesii, Agropyron smithii, and several others.

Small Unnamed Canyon Flowing South
Through the East 1/2 of Sec. 25
NE Corner of Sec. 35, T21N, R24E

Fletcher, Fischer, and Cully proceeded south below the stock tank following the drainage of the Canadian River.

In the upper reaches of the drainage, the slope is only 2 or 3° but it is eroded down to sandstone bedrock. Bouteloua curtipendula, Andropogon scoparius, and Amorpha canescens are common. Pinus ponderosa is established here and there on the scabrock on either side of the drainage proper. About a half mile below the tank the drainage deepens to form a shallow canyon. Conditions are mesic enough for the existence of a few scattered Elymus canadensis and P. ponderosa increases in density, but the dominant conifer is still Juniperus monosperma. The open shallow nature of this canyon together with the southerly aspect have prevented the steeper lower portion of the canyon from retaining many of the more mesic species found elsewhere in the study site. Although Pinus ponderosa disappears, Juniperus scopulorum still occurs along with the relatively common Forestiera neomexicana and widely scattered Populus fremontii. The lower half of this canyon comprises the steepest, most rugged drainage surveyed.

A primitive road, probably used for ox carts, parallels the canyon above the lip and on the east side. Apparently the larger trees in the lower canyon were cut for use along the road and here and there stumps are still in evidence. In most places, this road is not discernable from any distance and in spots the ruts have eroded to depths of more than six feet. On the open south-facing slope in this area, Quercus grisea is common, having, in large measure, replaced the typically more common Quercus undulata.

The floodplain of the Canadian River near the mouth of this canyon is grazed to the extreme. Rehabilitation problems are exacerbated by periodic flooding. About four miles below Mills Canyon Campground, a site some 50 feet above the canyon floor contained flood debris piled among the J. monosperma. These high water marks are at a point some 500 yards between

banks. Even without the effects of periodic flooding, utilization levels exceed that which most perennial forage can withstand. Cattle concentrations in some places along the floodplain have often left deposits of dung reminiscent of a stockyard.

Canyon de la Cueva Drainage
Secs. 12, and 7, T20N, R25E

The Canyon de la Cueva drainage was surveyed by Reggie Fletcher and Richard Spellenberg on July 1, 1981, beginning along the ridge north of the North Fork and proceeding to the spring on the rim of the North Fork due north of the confluence of the two forks, then down the North Fork to the main canyon and up the main canyon to the rim again in the SE 1/4 of section 6.

The north rim of this drainage forms a narrow cobbly bench gently sloping to the west.. The vegetation type is a Juniperus monosperma, Bouteloua gracilis woodland. Pinus edulis occurs occasionally and Quercus undulata is abundant in patches. Opuntia imbricata and the pad opuntias are also common.

Below the spring an earthen dam creates a small impoundment. Along the rim at this level, Pinus ponderosa is widely scattered, anchored in cracks in the sandstone. Above the tank, a 15'x20' abandoned rock house emphasizes the importance of this spring. In the mud of a walled-up overhang below the tank, a chert scraper was found.

In the defile below the tank, several small potholes provide suitable habitat for a variety of grass and grasslike species as well as Populus tremuloides, Rosa woodsii, and other mesic species whose presence is dependant upon a moisture-enhanced condition.

At midslope, there is a terrace containing Prosopis glandulosa, Baccharis wrightii, B. pteronioides, and Ephedra torreyana. The south-facing slope averages about 30°.

The canyon floor of the North Fork is boulder strewn but relatively mesic. The main canyon is accessible to livestock, therefore lacking in the diversity of its more rugged

counterparts. The main canyon also runs almost due east-west, allowing more dessiccation than in most of the other canyons. The south-facing slope is the most xeric of the habitats seen by Fletcher during the course of this study. This exposed slope contains the largest populations of the relatively rare Yucca neomexicana noted. Other south slope dominants are Nolina microcarpa, P. glandulosa, O. imbricata, O. phaeacantha, and J. monosperma. The north-facing slope is featured mostly by Q. undulata, P. ponderosa, J. scopulorum, along with a few examples of J. monosperma. Pinus edulis, almost absent on the steeper slopes, becomes more prominent as the slope decreases.

Fallugia paradoxa occurs at its highest stage of development in the study area in this canyon. Populus X acuminata and P. fremontii are also present but the hardier Salix exigua is more common than either of these taxa.

Approximately 300 yards up the main canyon from the forks is the only permanent natural water in the canyon. Here a pothole provides a habitat for Typha angustissima, Alisma trivale, and Tamarisk pentandra.

Historical Aspects

Perhaps the most significant cultural resource in the study area is the remains of the orchard and stone house located on the floodplain of the Canadian River in the immediate vicinity of the Mills Forest Camp.

Melvin Whitson Mills built the now ruined rock house and adjacent adobe buildings on land homesteaded by his father Daniel in 1870. The house, built in 1881, apparently served as headquarters for the surrounding orchard and as a stage-coach stop for Mills' Concord Coach Line. The coach line, originating in Kansas, ran from Clayton across the Canadian River to Fort Union. Although improved by the Civilian Conservation Corps, the same route one now follows from the rim to the floor of the canyon (Route 600) served as the Canadian River crossing for the stage line.

The orchard is reported to have contained some 14,000 trees. Among them were peaches, apples, pears, cherries, apricots, plums, mulberries, quinces, nectarines, grapes, walnuts, chestnuts, pecans, and almonds.

In October, 1904, the river flooded and left the orchard in ruin. The last supervised harvest occurred in 1912.

Today, only a few scattered, decadent trees remain from the thousands that once flourished along the canyon bottom. Without proper pruning, few of these trees will survive more than a few years more. Although the ruined rock house with its metal fruit-drying cabinets and giant timbers from the cider press provide unique attractions for the canyon's visitors, the remaining fruit trees still provide a valuable resource.

While few in number, one still finds pear, apple, apricot, honeylocust, mulberry, walnut, pecan, plum, and osage orange growing along the canyon floor. Proper pruning would rejuvenate many of these now dying trees and add many productive years to their life.

Source: Albuquerque Journal Magazine, Impact, Vol. 4, No. 7, Dec. 2, 1980, by Fritz Thompson. Paraphrased from Article titled "Melvin Mills: A Faded Legacy."

Geology

Most of the study area consists of what, at first glance, appears to be relatively homogeneous sandstone. However, between the village of Mills and the bottom of the Canadian River Canyon to the west, a drop of nearly 1000 feet, one passes through strata representing Cretaceous, Jurassic, and Triassic ages. The more prominent formations from the top down are as follows:

Carlile shale--a dark gray shale with thin beds of limestone at the top. A narrow band of this shale is encountered just west of Mills.

Greenhorn limestone--a light tan limestone containing thin beds of shale. This formation forms the knolls, hills, and breaks just west of Mills in the upper portions of the valley.

Graneros shale--a dark gray shale with two or three thin beds of limestone. This formation underlies the grassland which stretches between the hills and the lip of the canyon.

Dakota sandstone--a lenticular to parallel-bedded gray shale, shaley sandstone, and sandstone. The basal unit is uninterrupted massive sandstone. Dakota sandstone outcrops occur near the rim of the canyon.

Morrison formation--a greenish gray-green and reddish brown sandy clay with local beds of white to brown sandstone, siltstone, and minor limestones. This is the first formation of Jurassic age.

San Rafael group--probably represented by the massive, white to pink, fine-grained Entrada sandstone.

Dockum group--a thin-bedded light brown sandstone and a light green, red, reddish-brown, and purple mudstone. This member of the Triassic age forms the lower portions of the canyon.

Maps 1-21. Vegetation maps of the Canadian River Canyon and vicinity. Each map shows six sections and the appropriate coordinates are indicated at the top of each map. Where applicable, certain topographical features are shown. The vegetation indicated is representative of the dominant plants of the area as determined by both ground survey and arial photos. The following legend characterizes the symbols used:

G=Grassland.

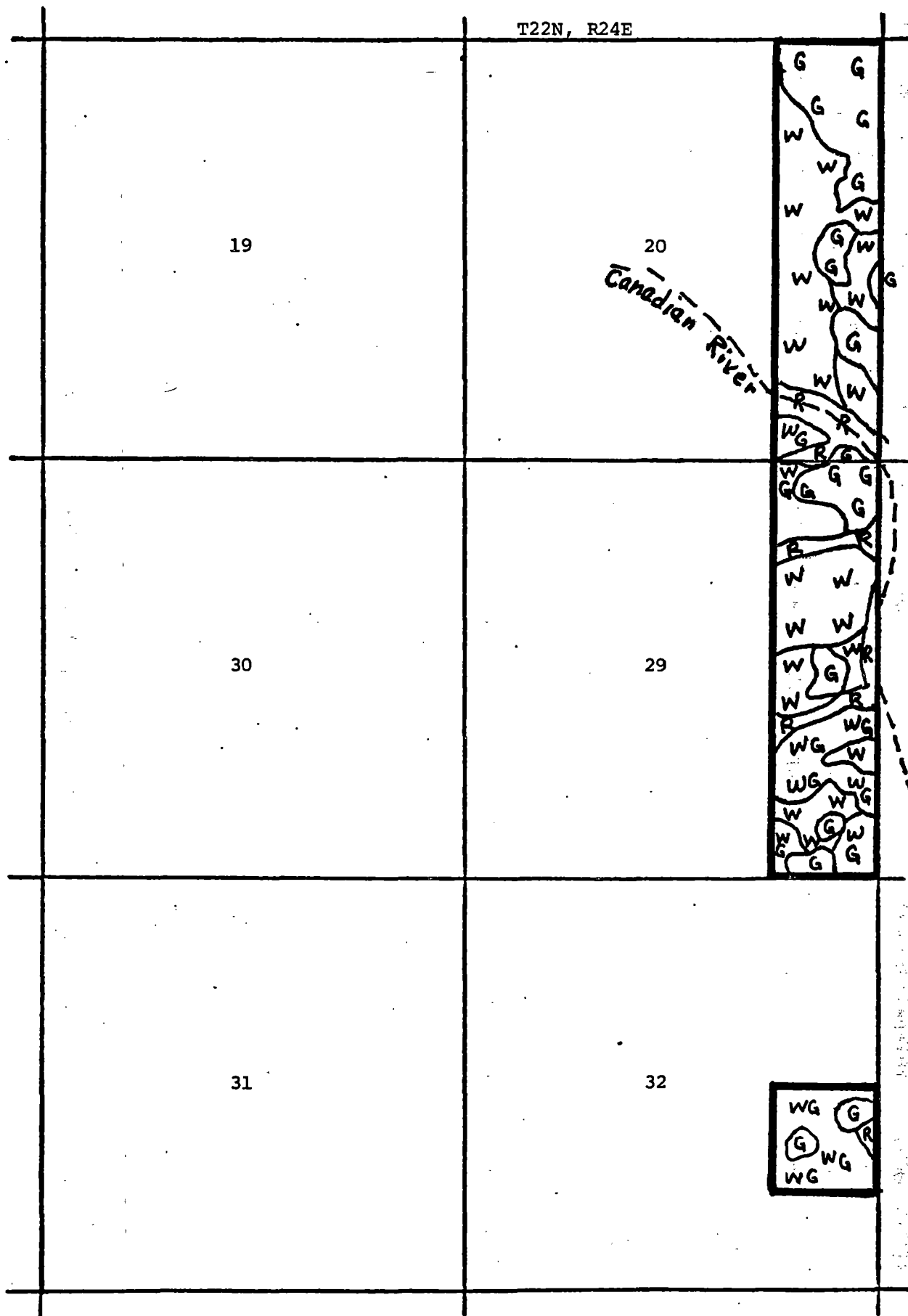
WG=Mixed grassland and woodland.

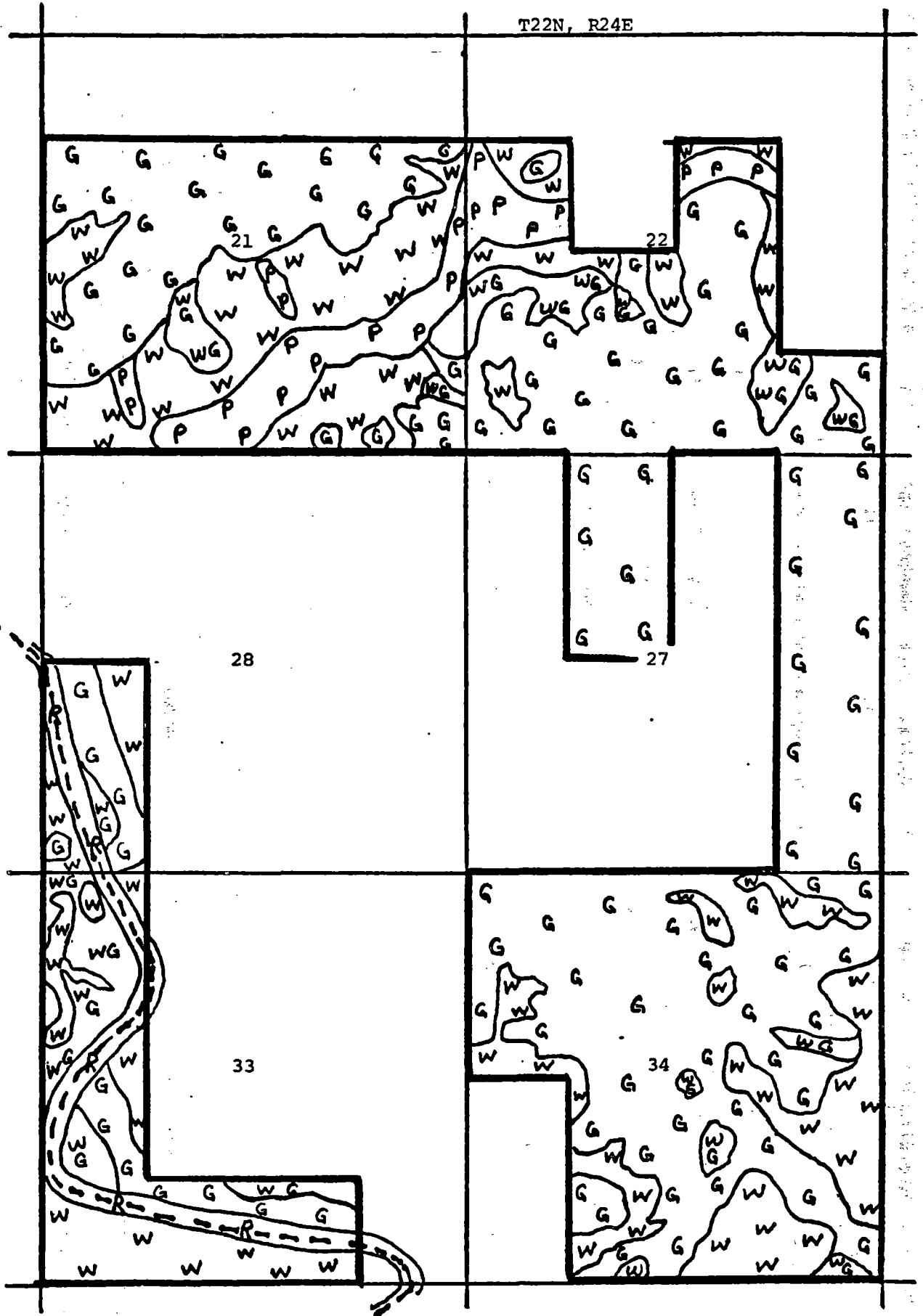
W=Woodland (usually Pinyon-Juniper)

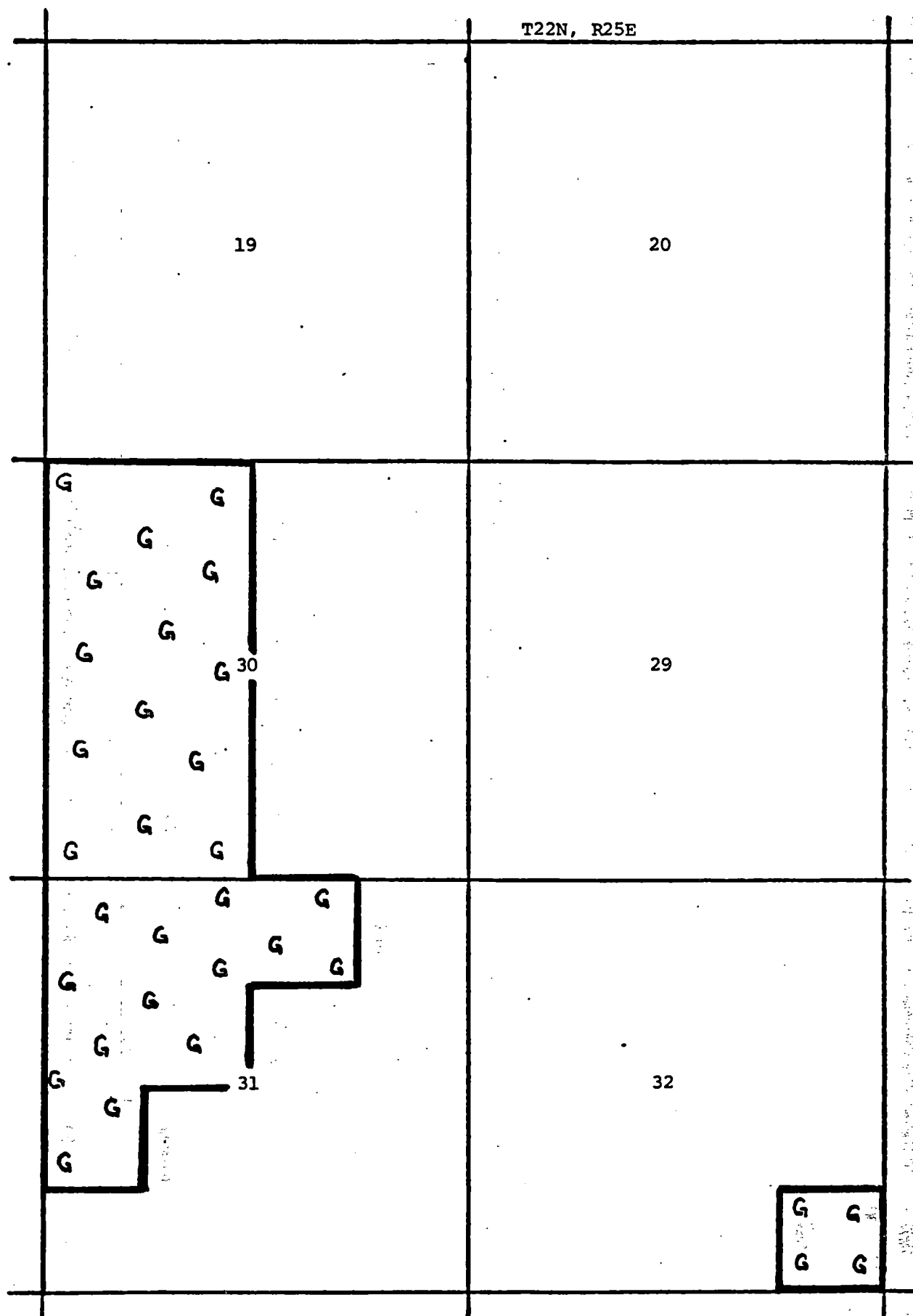
P=Ponderosa pine and associated taxa.

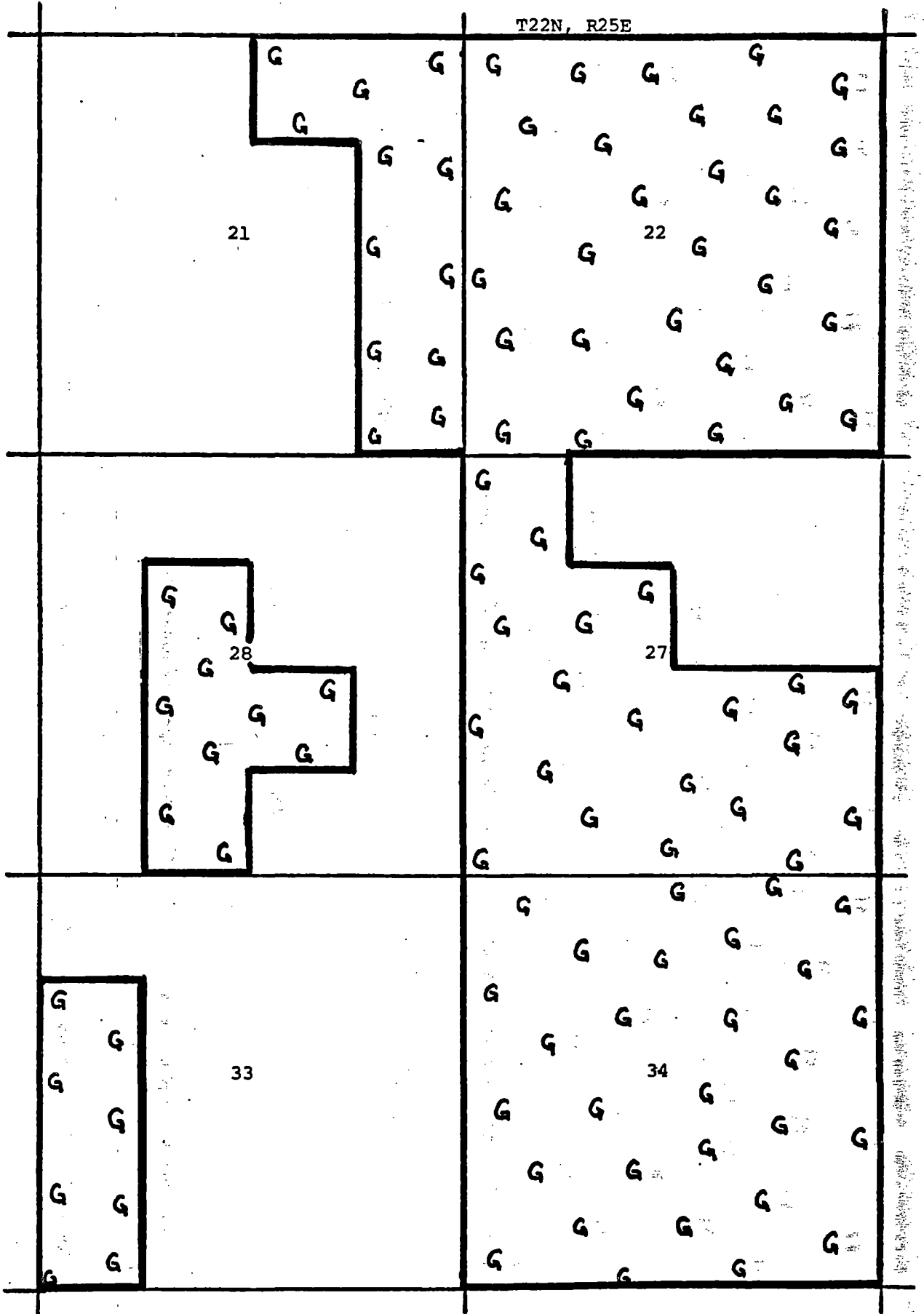
R=Riparian species.

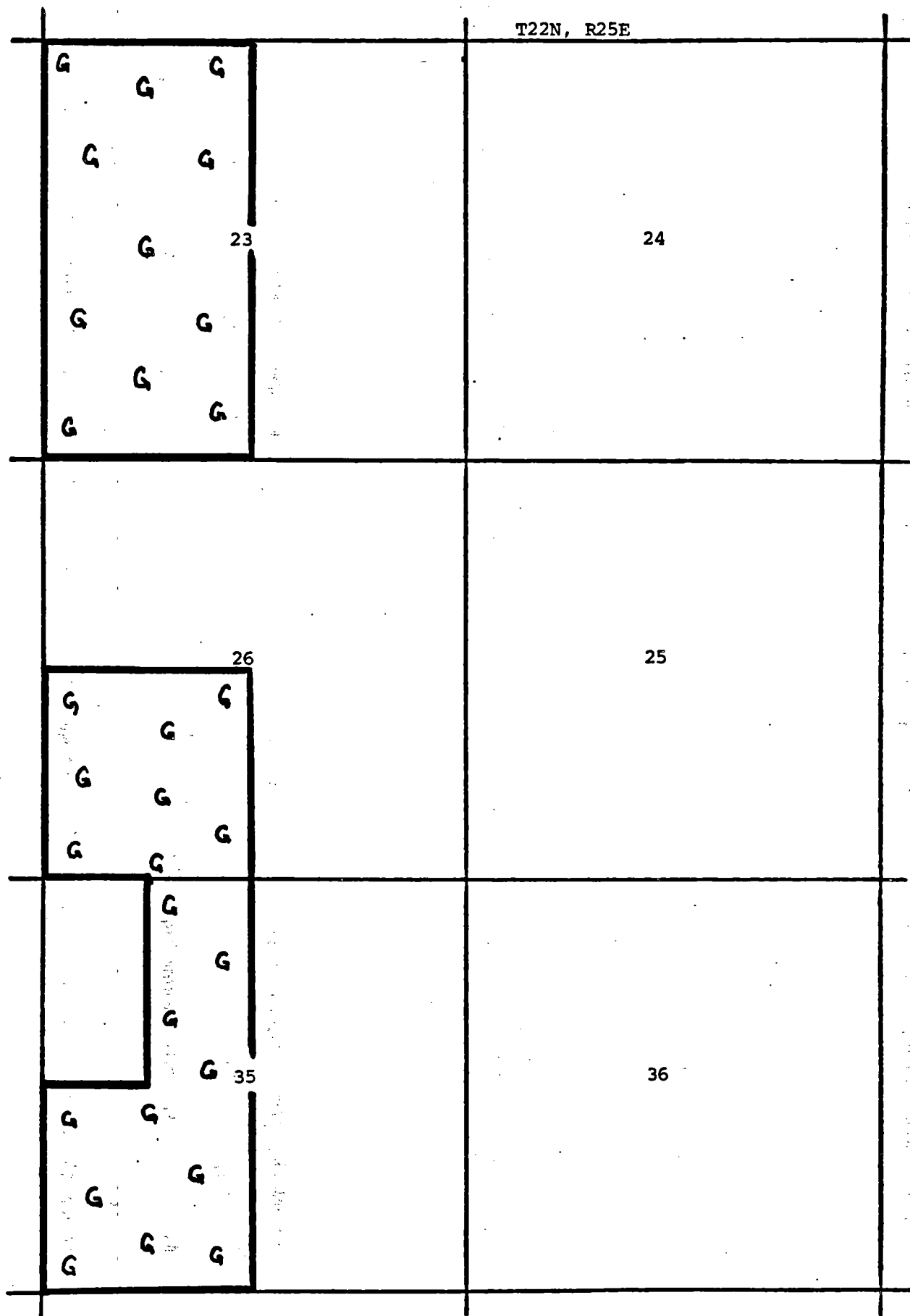
T22N, R24E

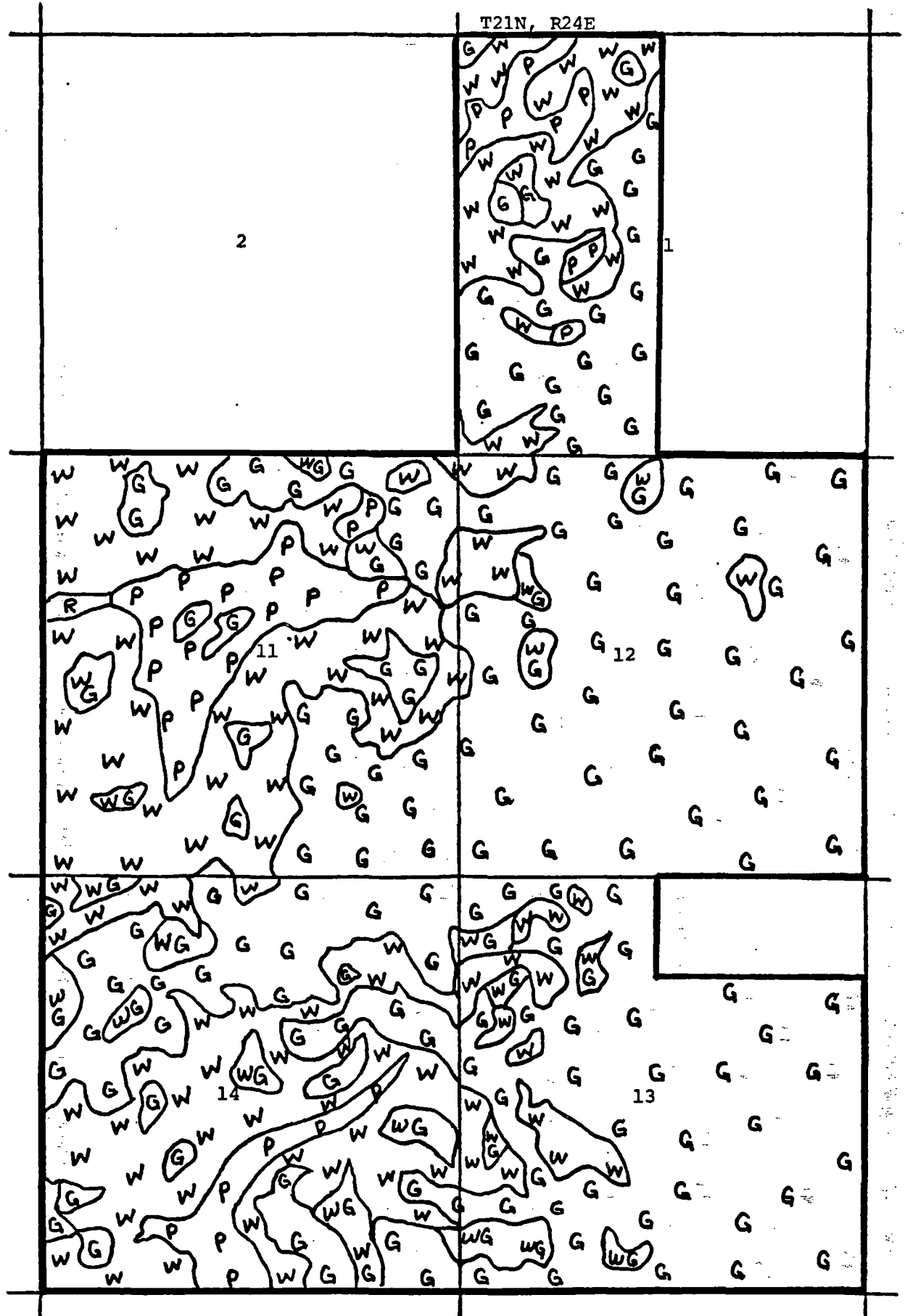


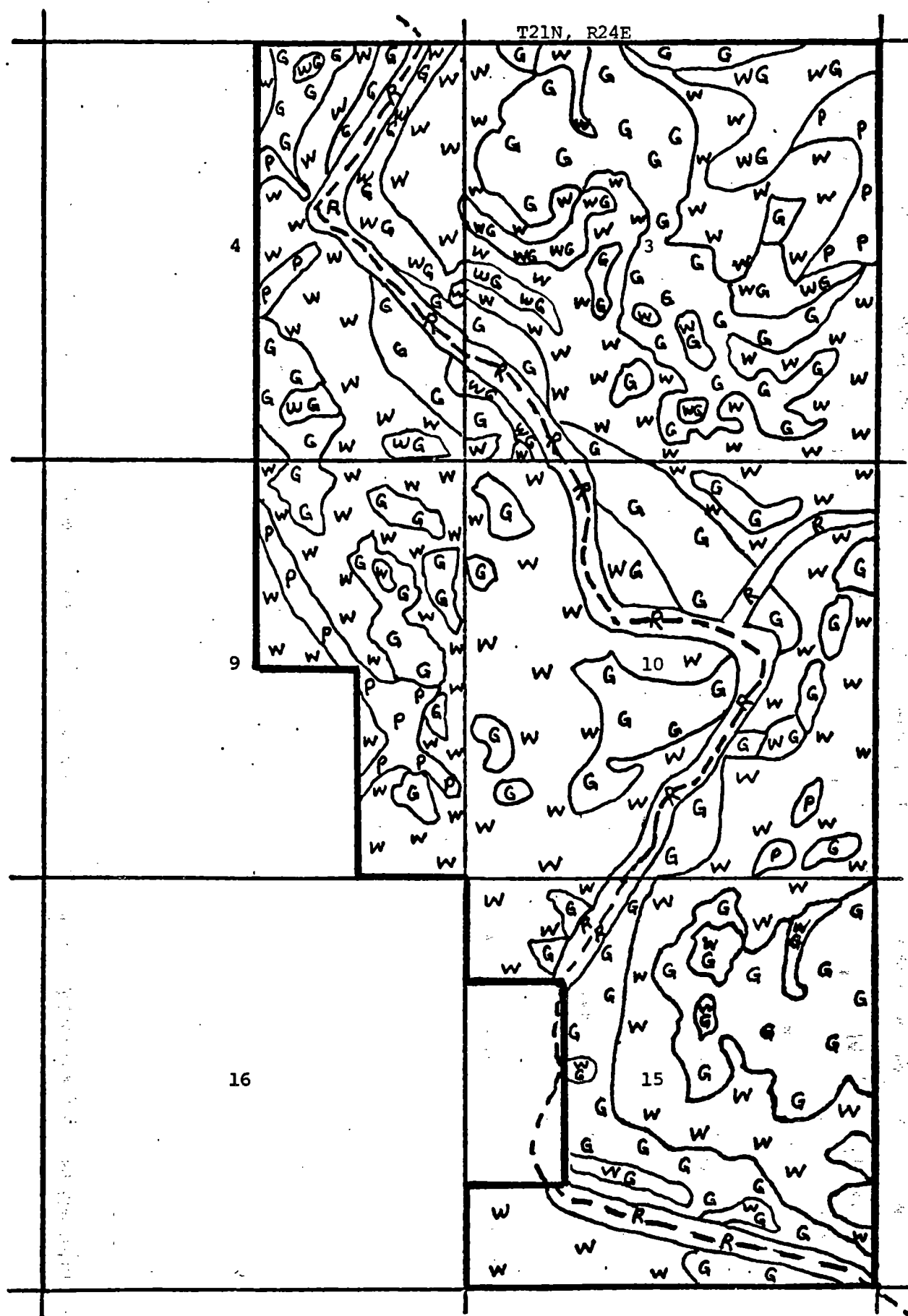


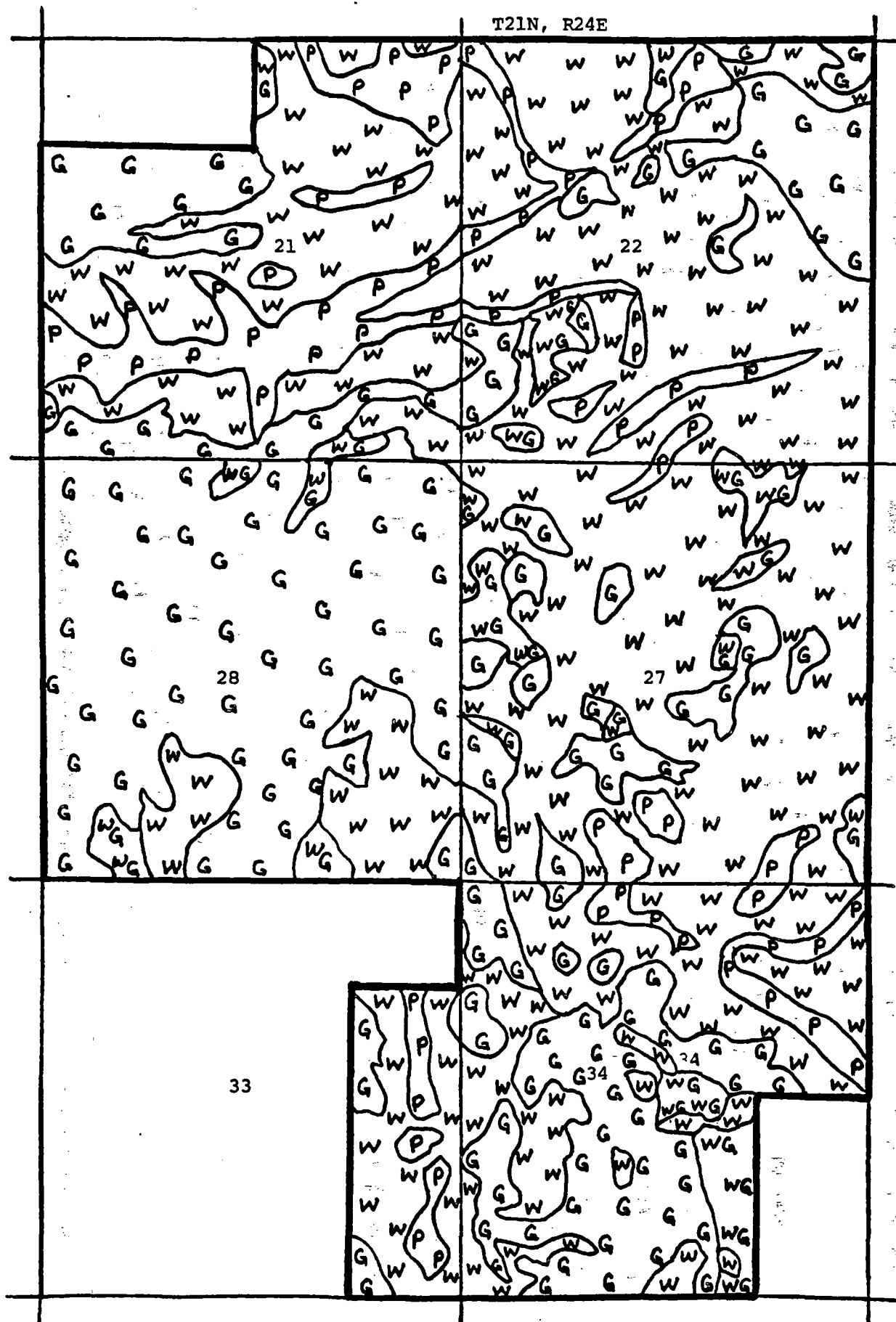


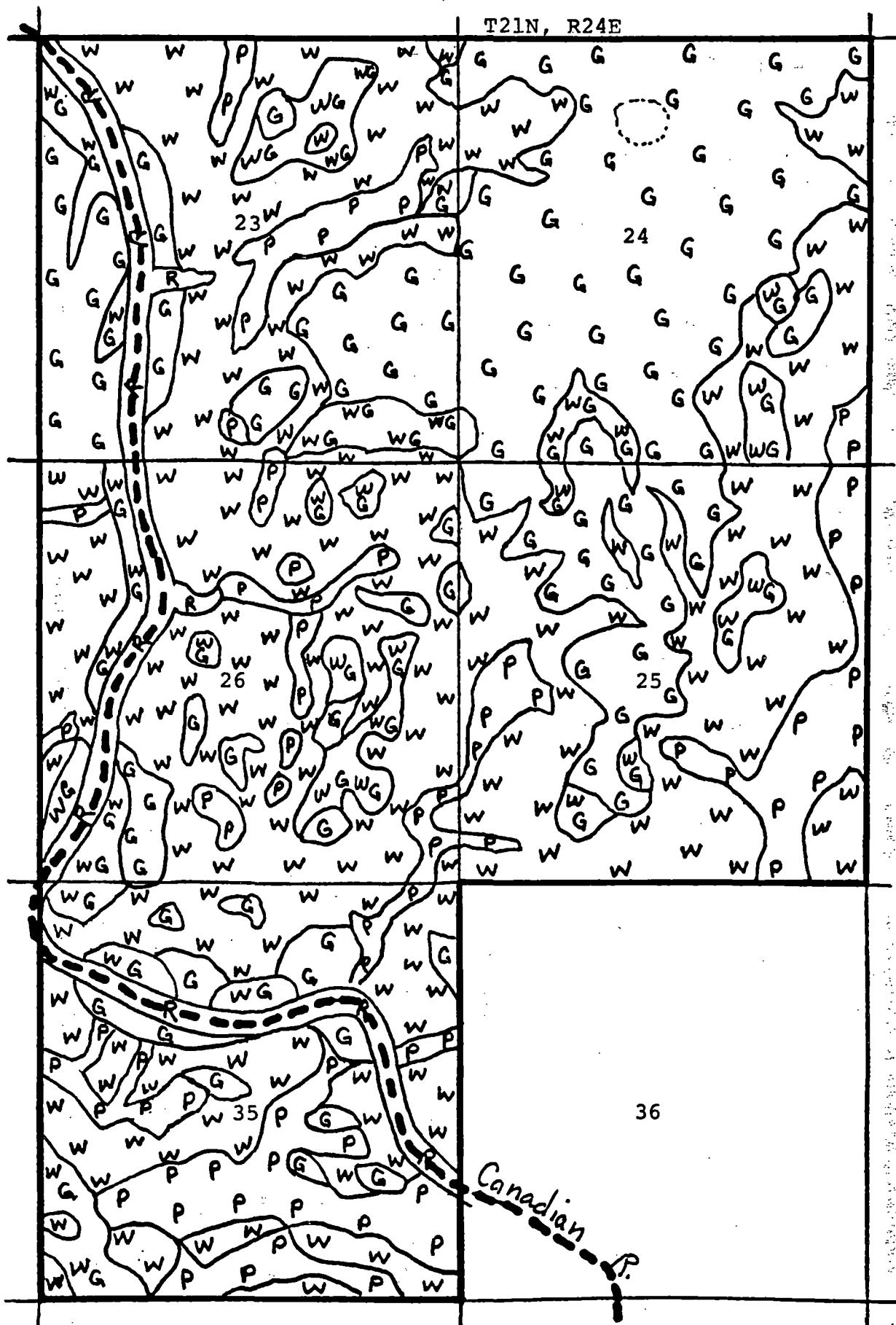


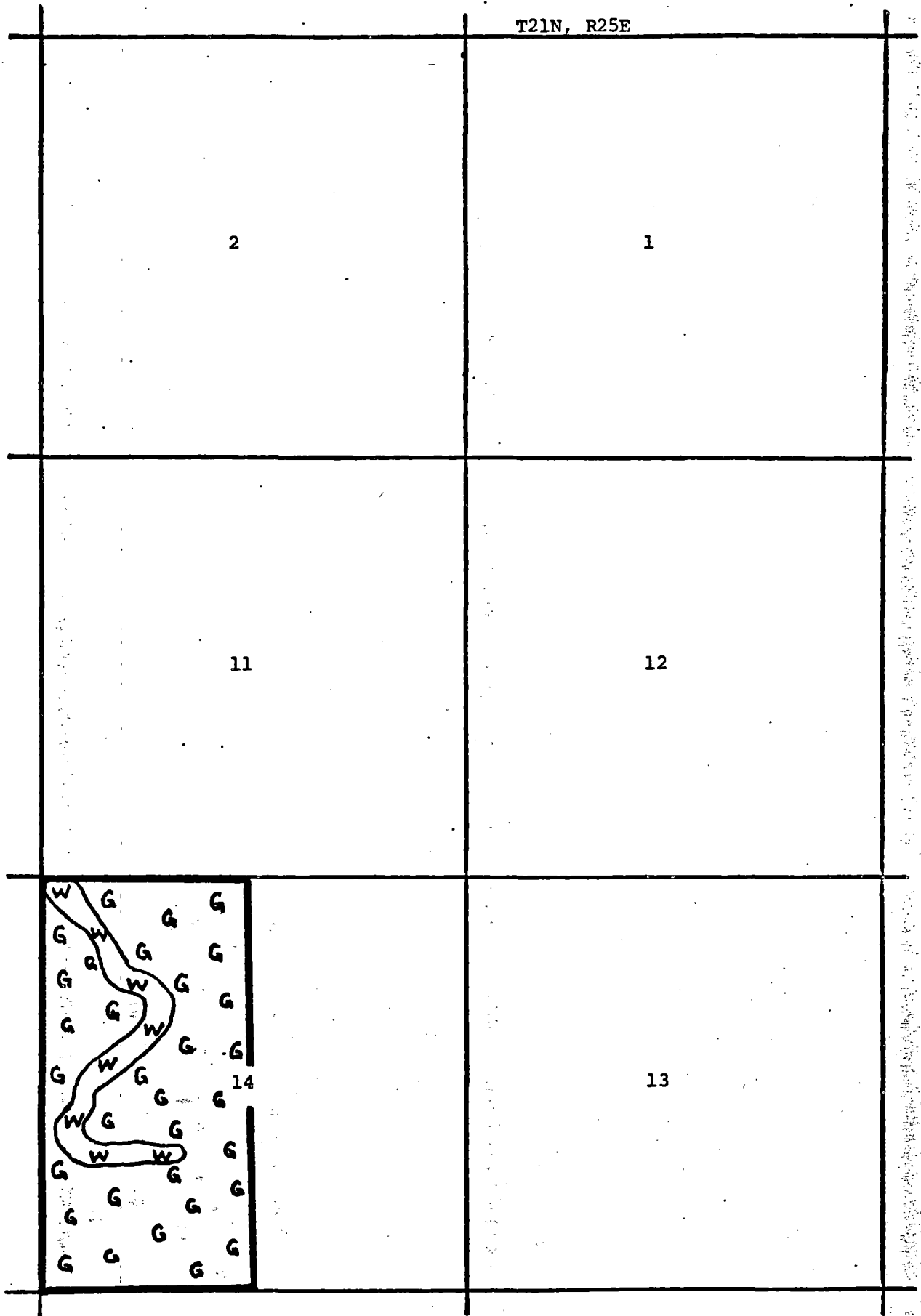


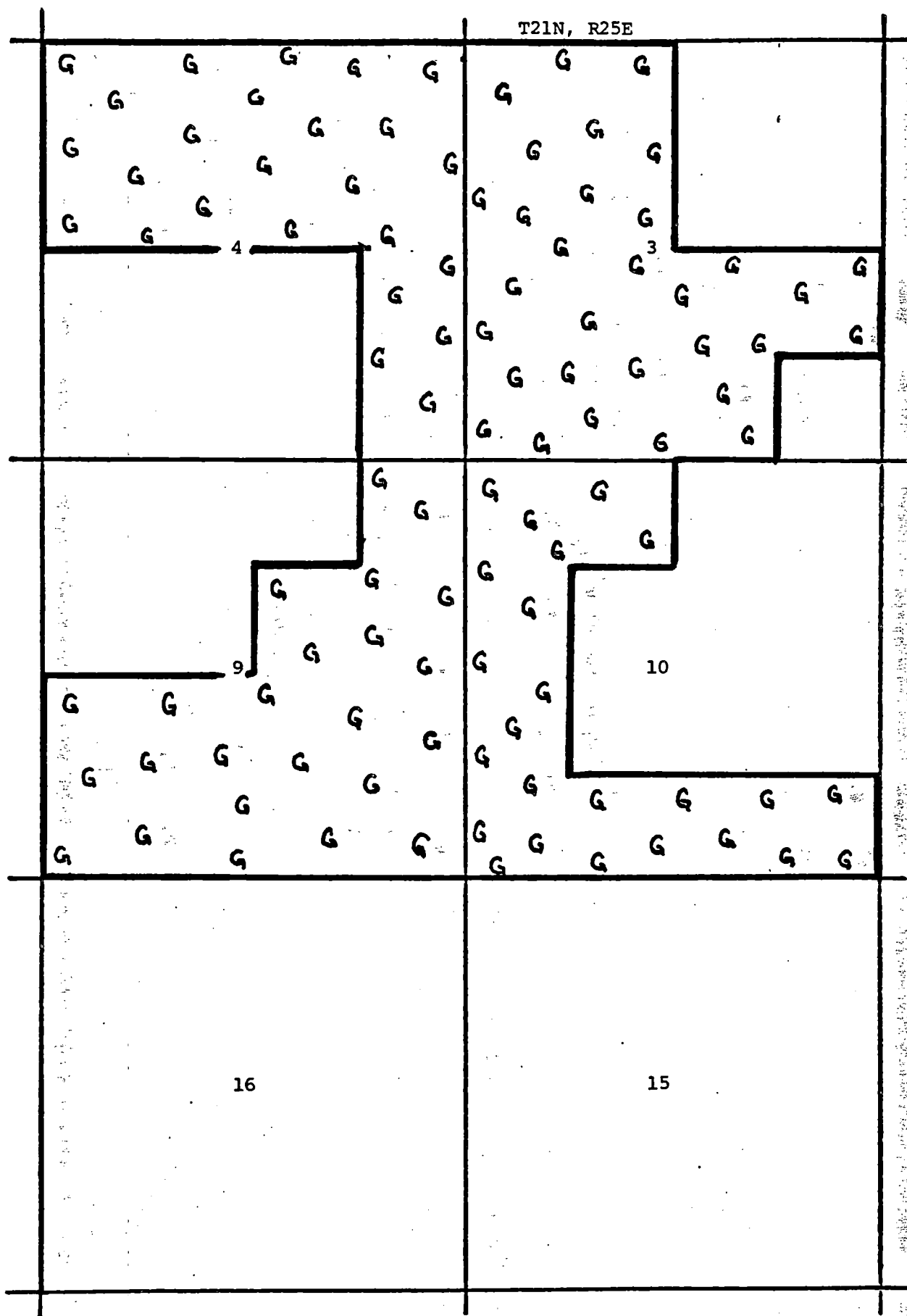




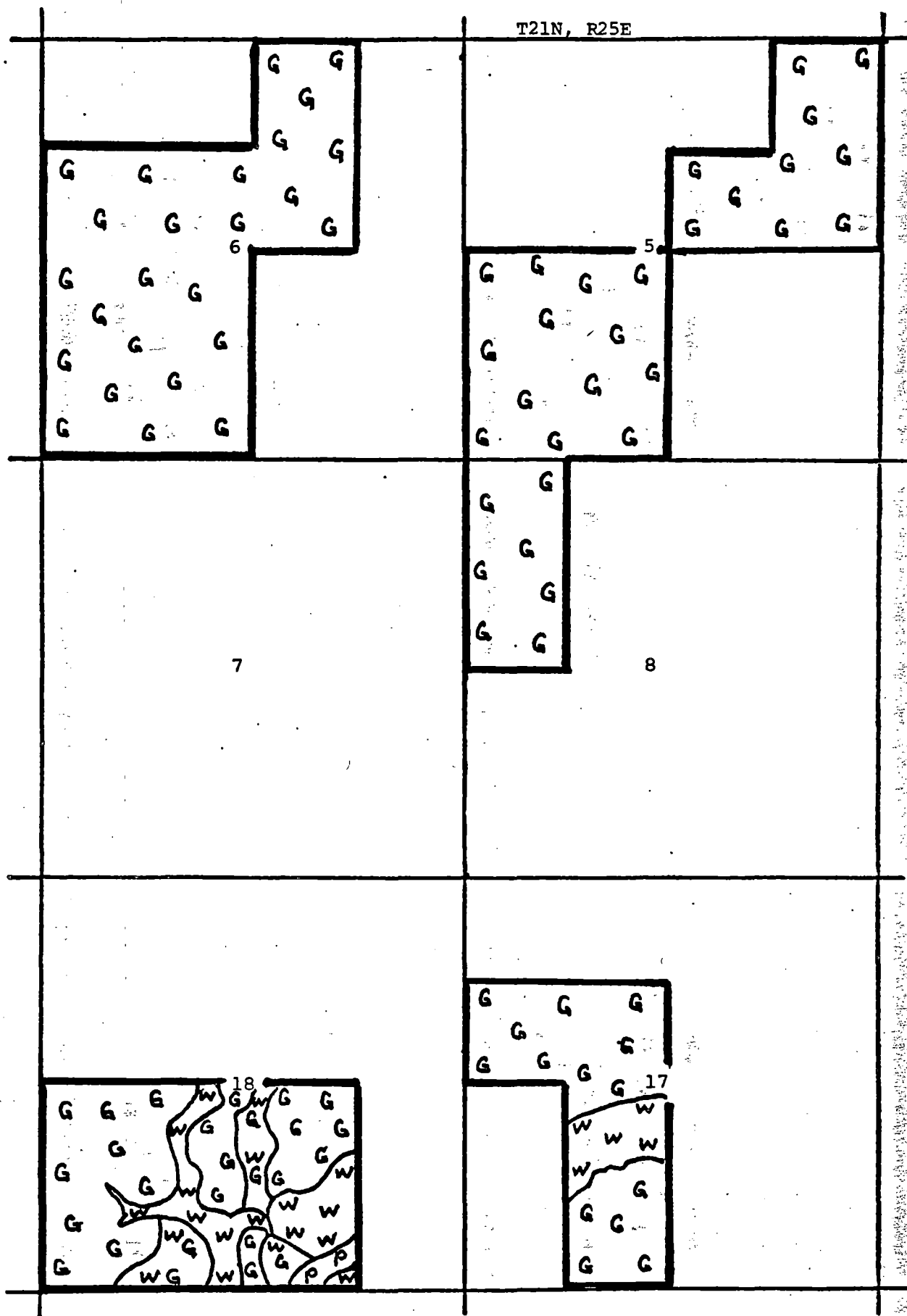


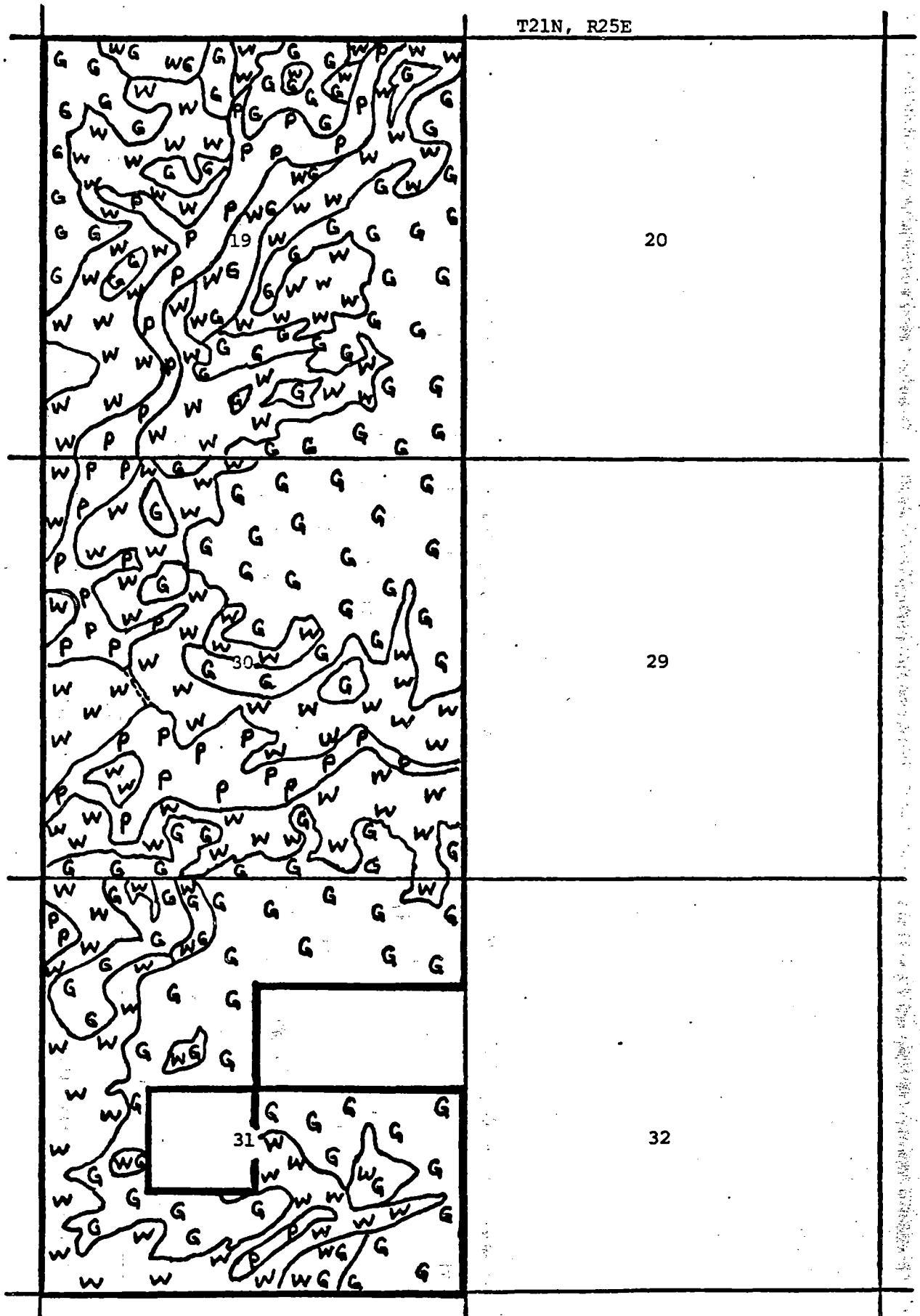




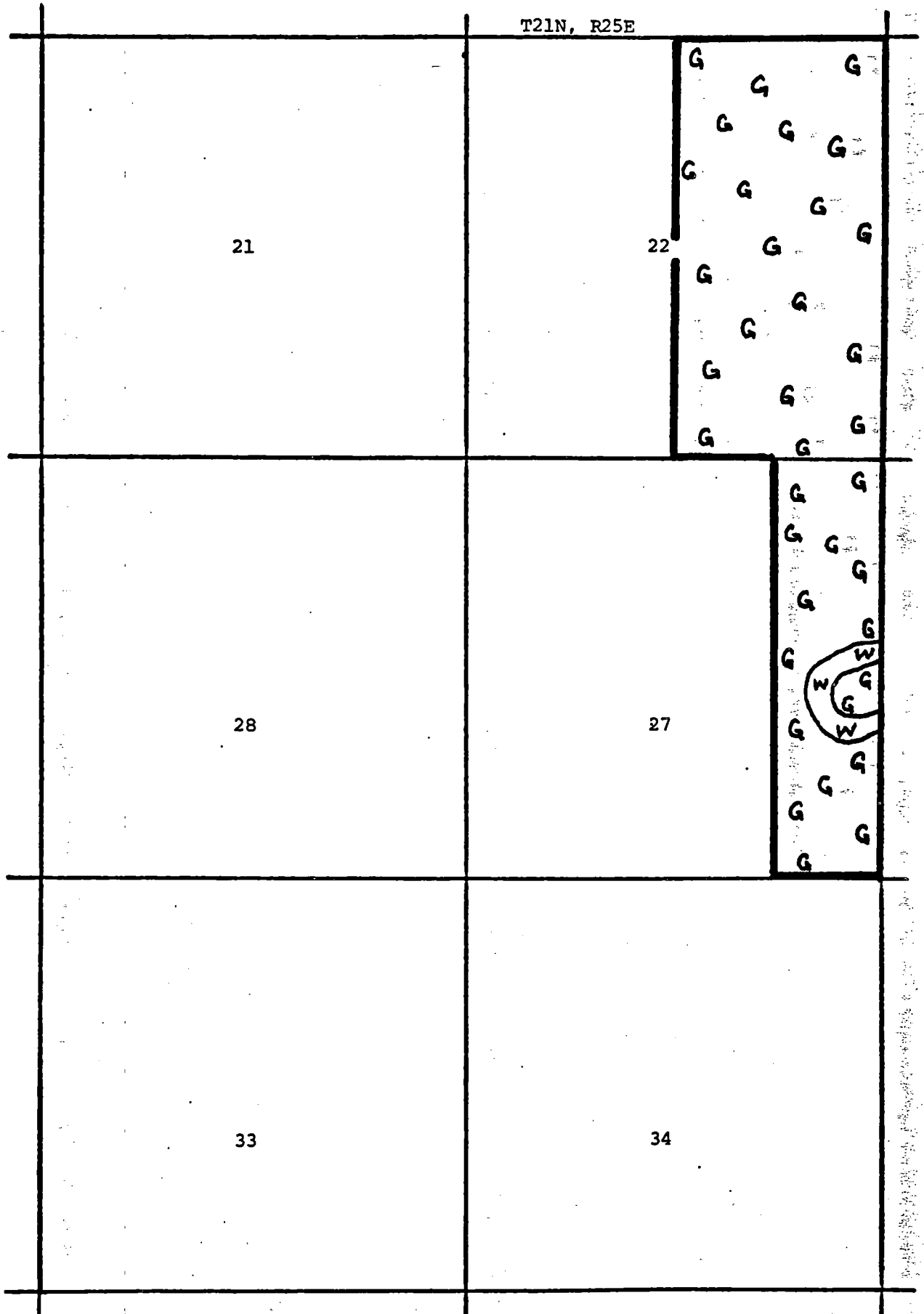


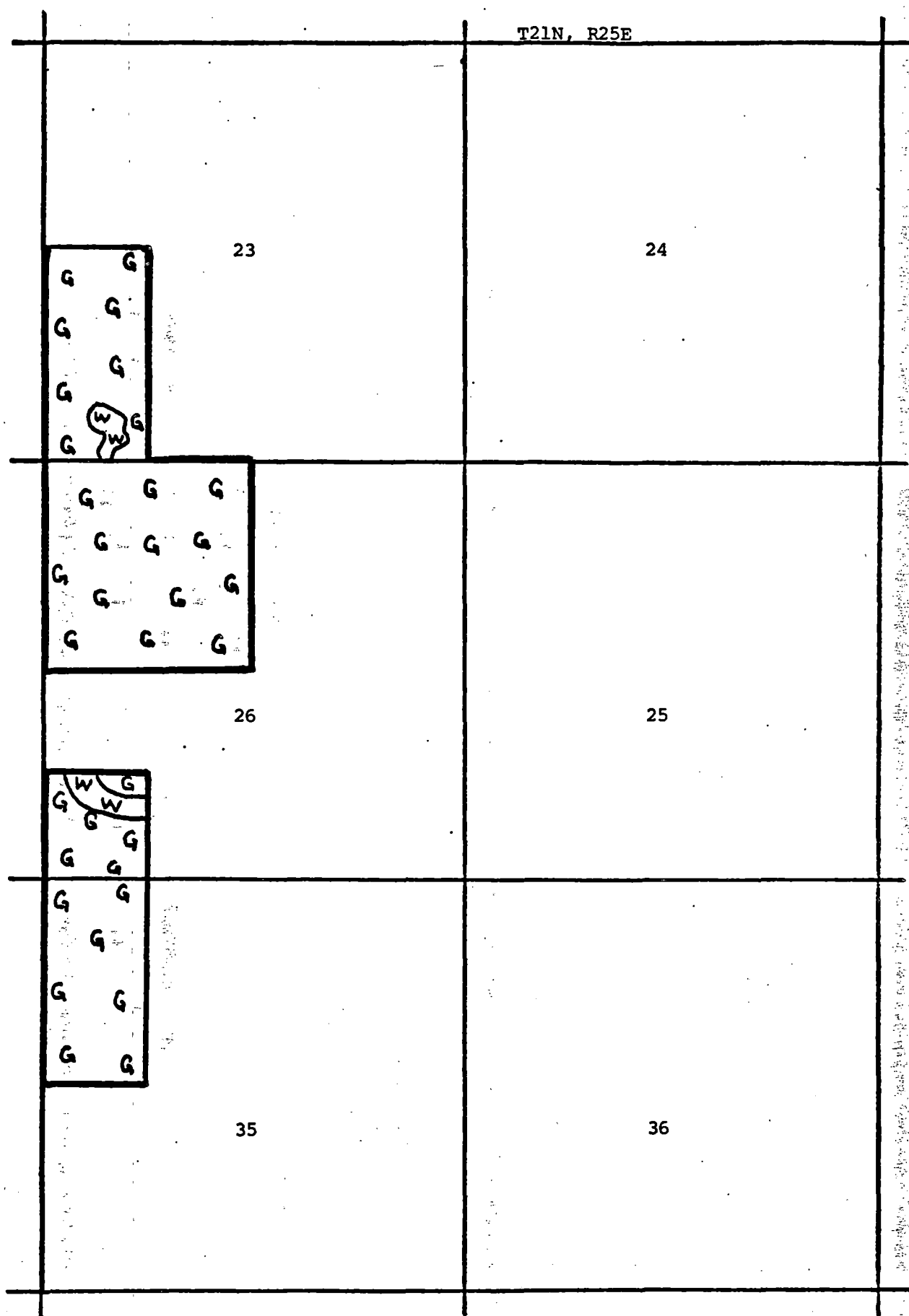
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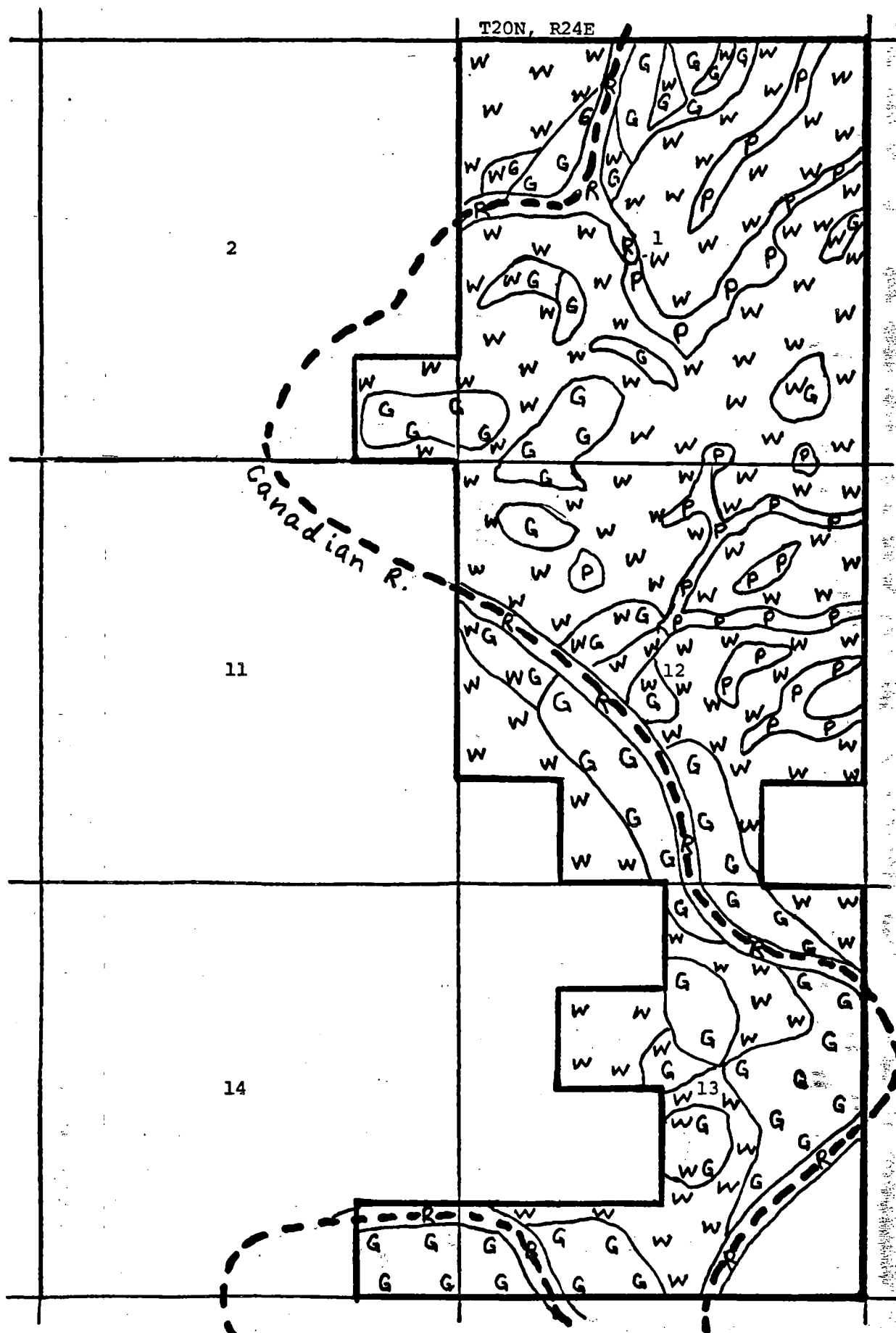


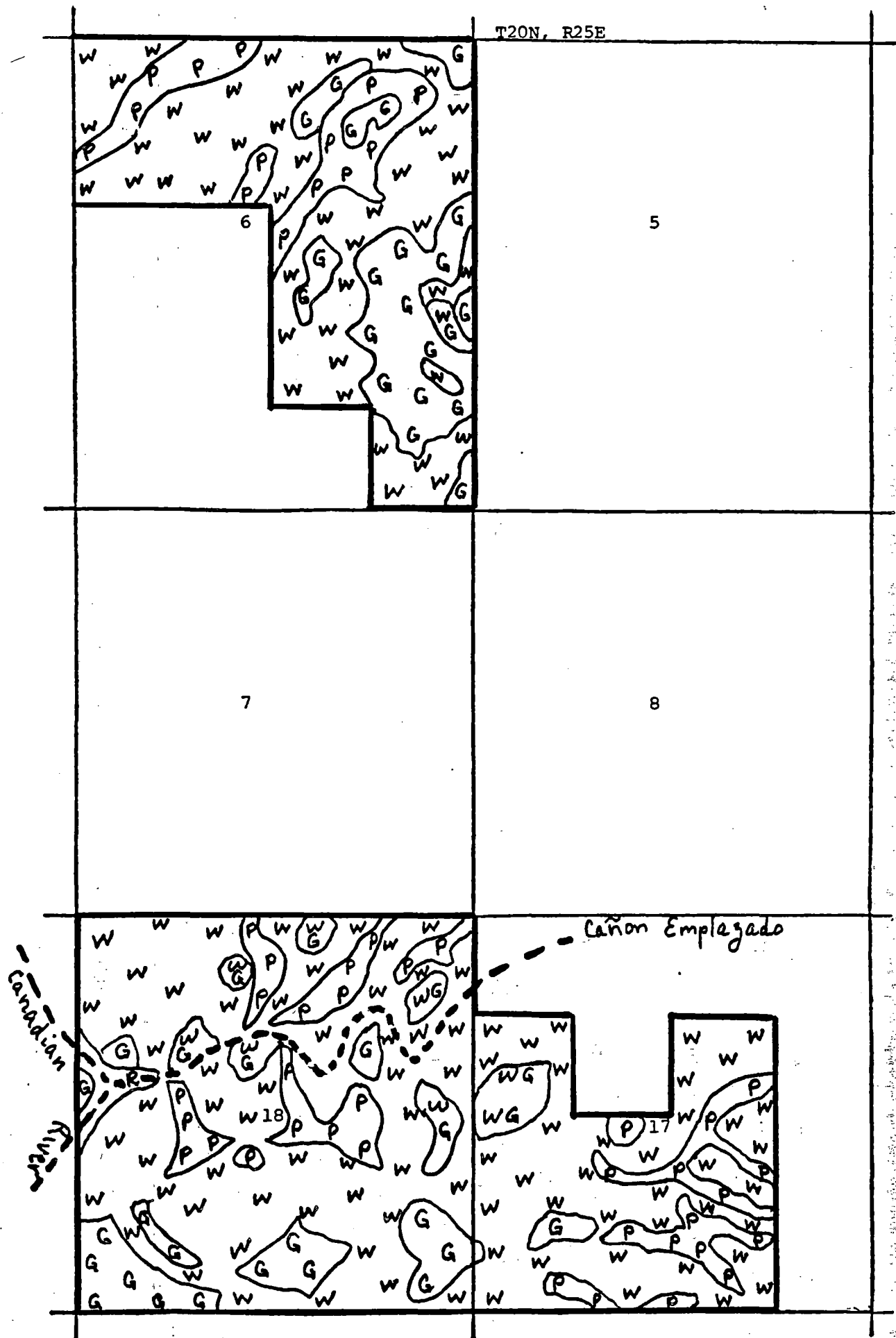


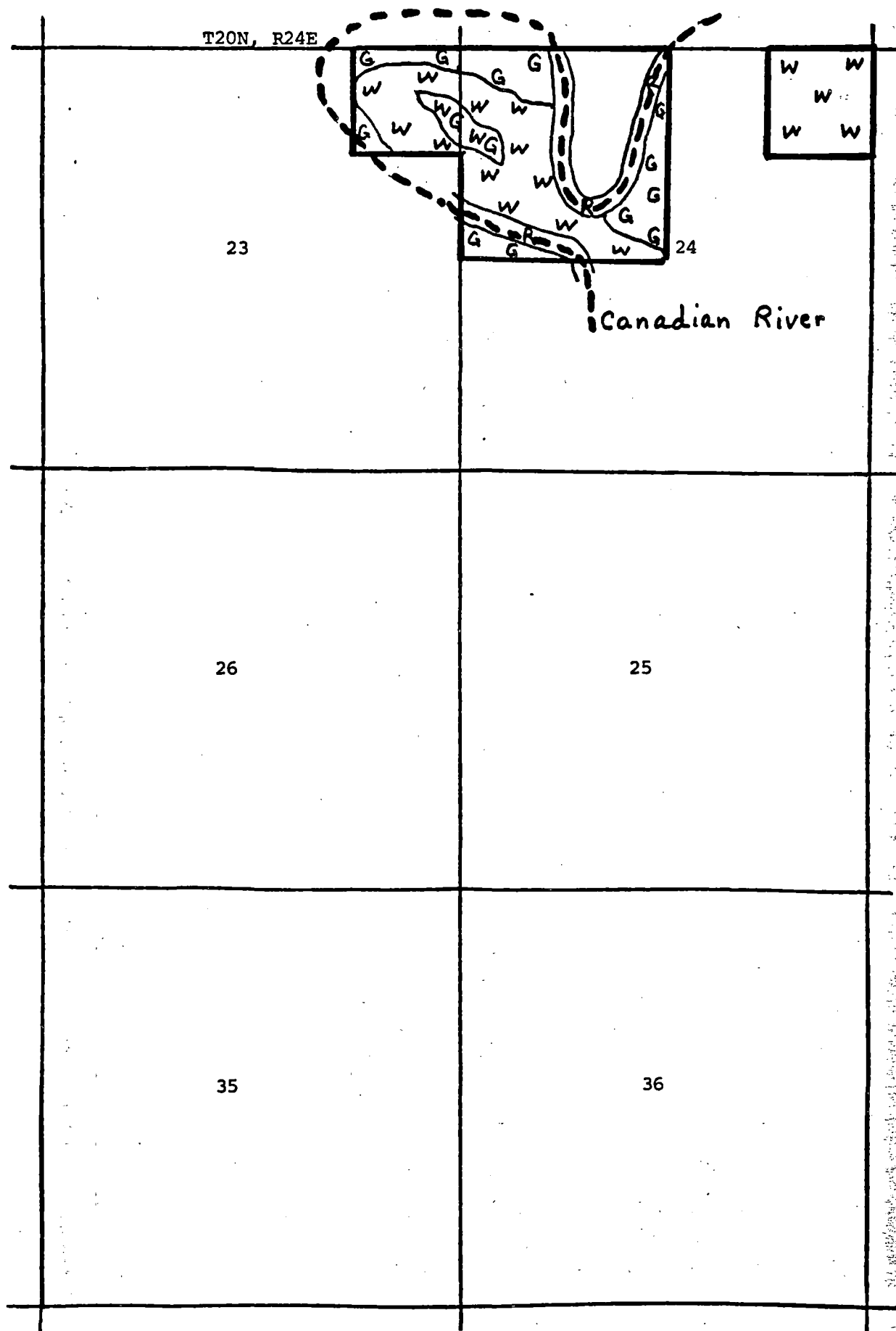
T21N, R25E











T20N, R25E

4

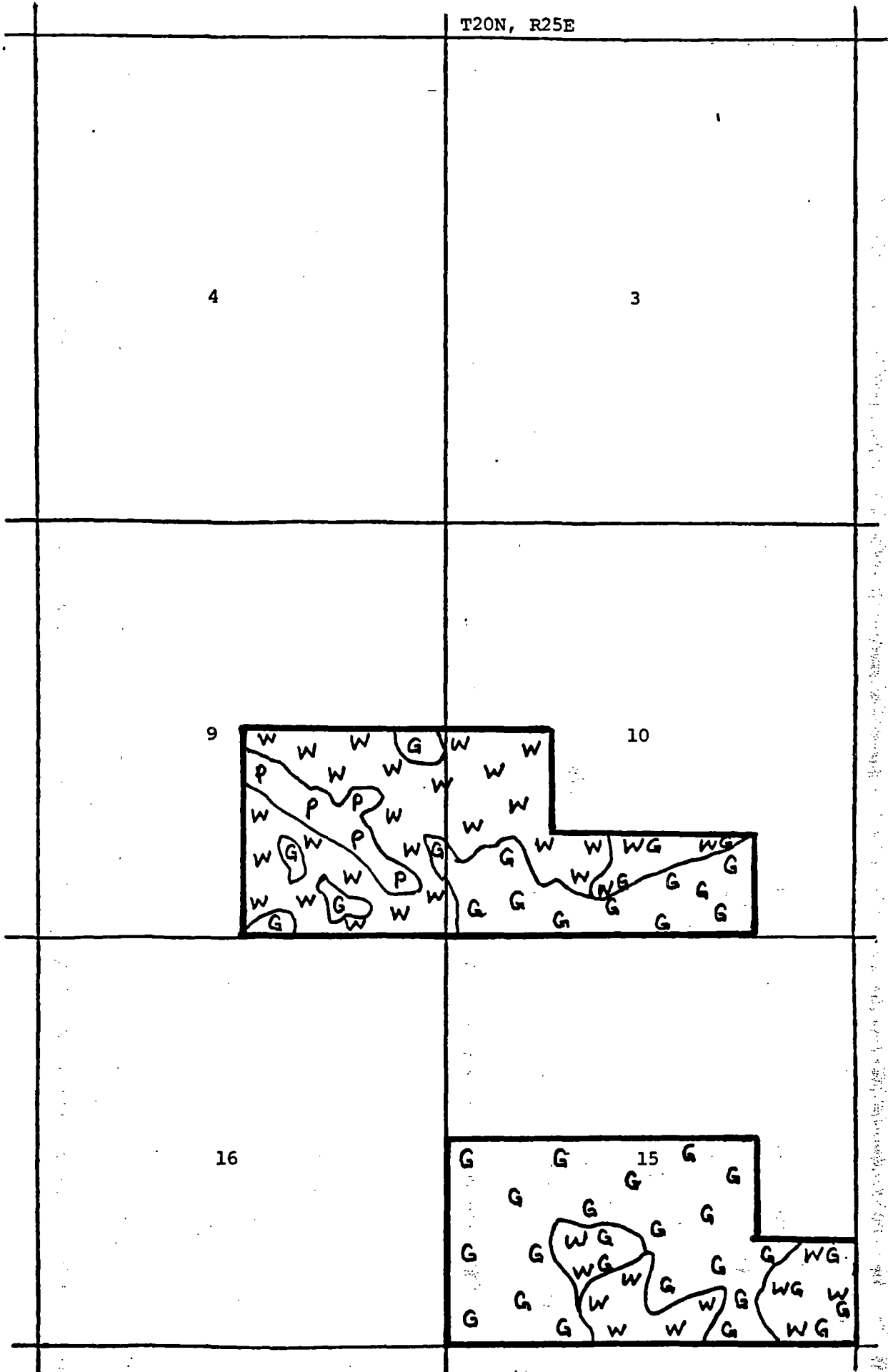
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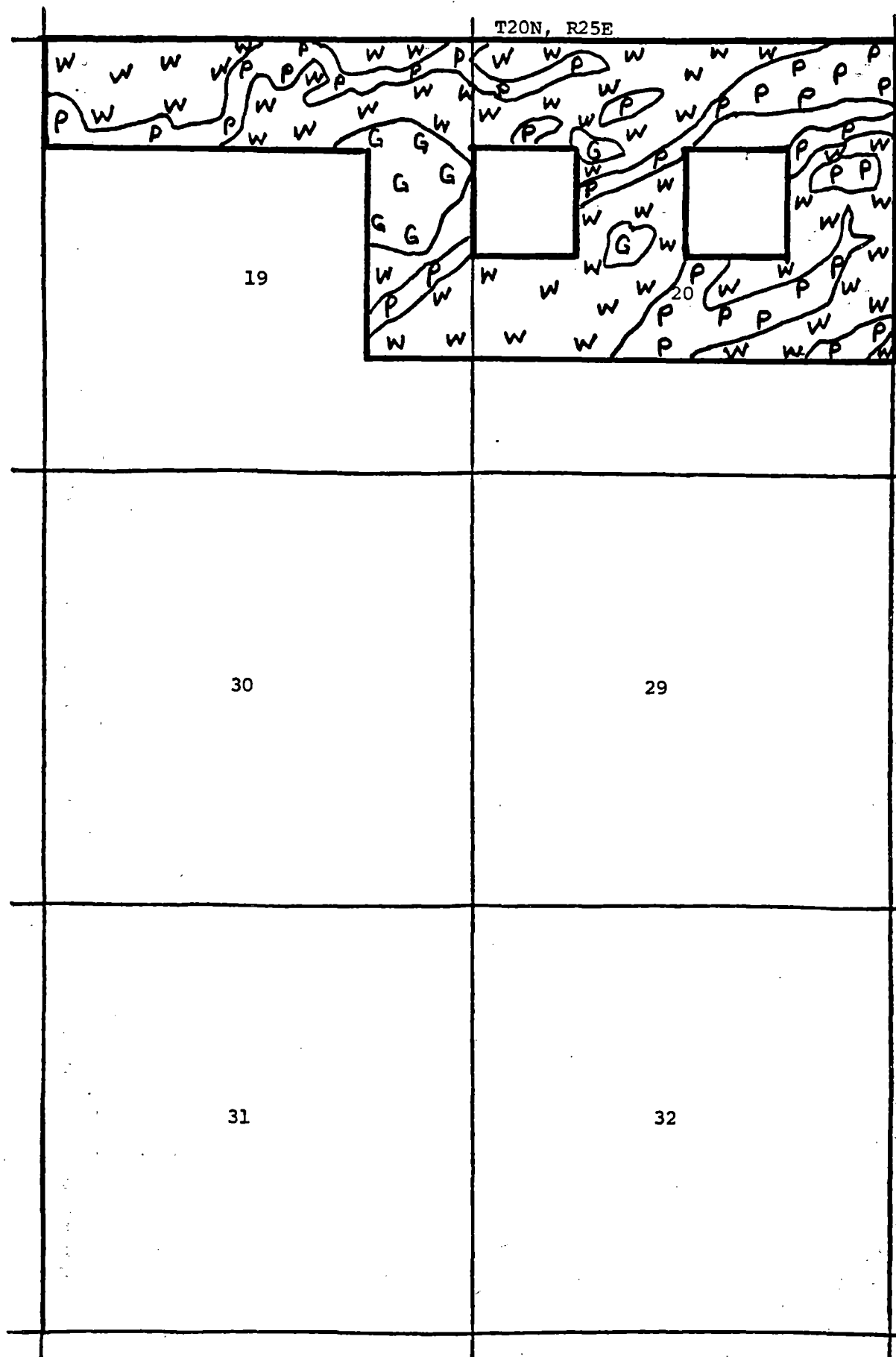
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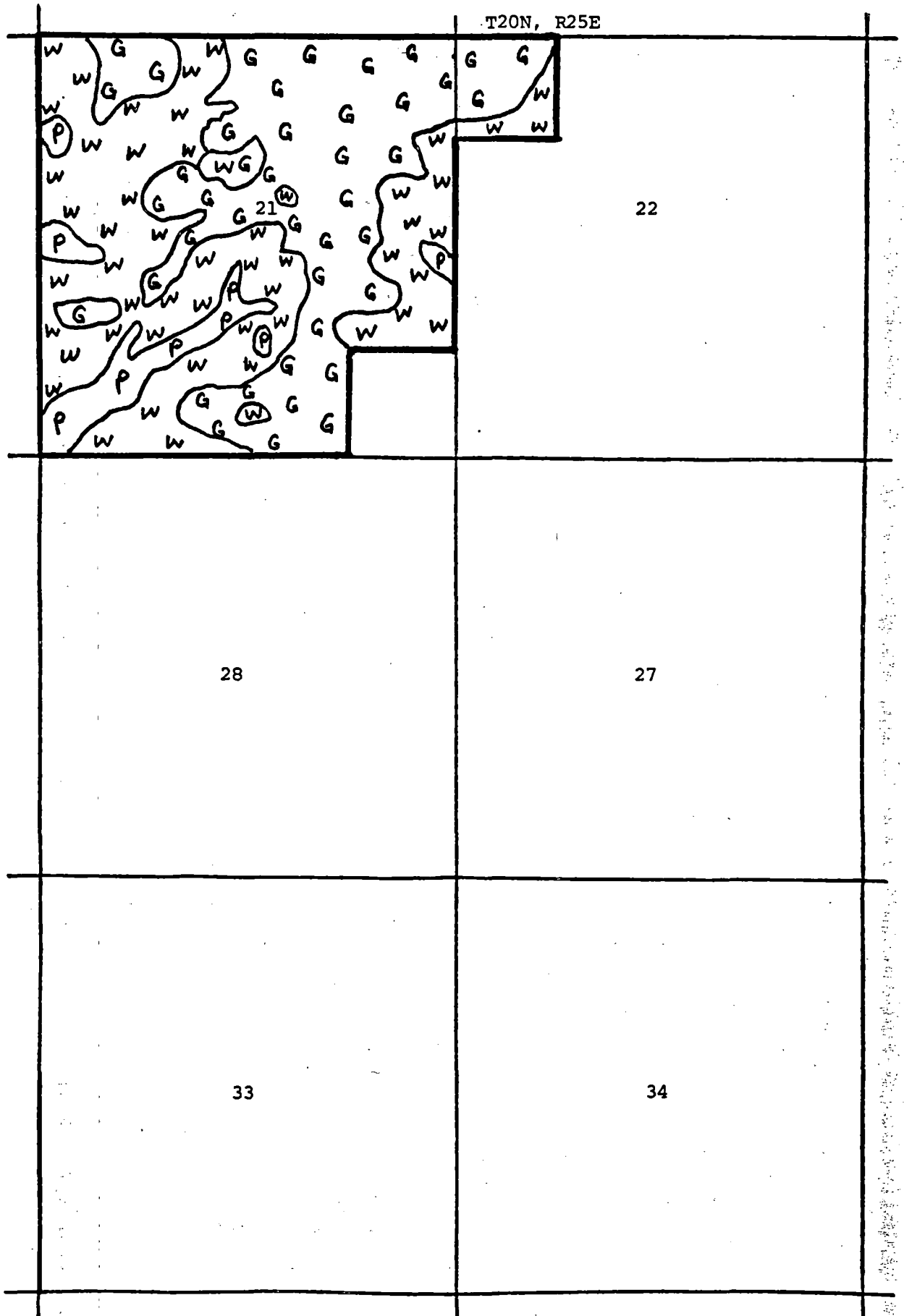


Table 1. Annotated checklist of the flora of the Canadian River Canyon and surrounding areas.

Plants are listed by family, genus, specific epithet, and subspecific epithet if applicable. Where possible, common names are also given.

Reference to habitat areas are presented as a letter code surrounded by parentheses. The reference code for the various collection areas represented is characterized on the following two pages.

Families are listed alphabetically including both flowering and nonflowering plants. Genera and species are also listed in alphabetical order.

Plant names preceded by an asterisk are representative of those taxa collected during the second phase of this study (September 17, 18, 1981).

Reference Code for Collection Areas

- A. Vercere Canyon, lower section, Sec. 22, T21N, R24E; 5150-5300 ft.
- B. Vercere Canyon, upper section, Sec. 21, T21N, R24E; 5300-5900 ft.
- C. Rim area, west side of Canadian River, SW 1/4 Sec. 22; 5900 ft.
- D. Along Canadian River, vicinity of Mills Forest Camp, Sec. 10,15; 5150-5200 ft.
- E. East side of Canadian River, spring and small canyon, Sec. 14; 5200-5750 ft.
- F. Tank and surrounding prairie, NE 1/4 Sec. 23, W 1/2 Sec. 24; 5800-5850 ft.
- G. East side of Canadian River, small canyon below tank, W 1/2 Sec. 25, NE 1/4 Sec. 35; 5050-5850 ft.
- H. Canadian River area below Mills Forest Camp, Sec. 35, 26, 23; 5050-5150 ft.
- I. Spring, north fork of Canyon de la Cueva, NE 1/4 Sec. 12, T20N, R25E; 5050-5550 ft.
- J. Canyon de la Cueva, EC 1/4 Sec. 12, N 1/2 Sec. 7, T20N, R25E; 5050-5700 ft.
- K. Limestone hills between Hwy 39 and 3 miles west of Mills; 6000 ft.
- L. From 1/2 mile to 1 mile northeast of Abbott Lake, Sec. 13, 18,19, T23N, R25E; 5800-6000 ft.
- M. Plains along Mills Canyon Road, Sec. 12, T21N, R24E; 5700-5850 ft.
- N. Upper slopes and rim, Biscante Canyon, SW 1/4 Sec. 22, NE 1/4 Sec. 28, T22N, R24E; 5800 ft.
- O. From 1 mile north of Mills to 6 miles north of Mills; 5900-6150 ft.
- P. Canyon along Route 600, N 1/2 Sec. 11, T21N, R24E; 5500-5700 ft.
- Q. Canyon Colorado, Sec. 8,9,10, T21N, R24E; 5800-5900 ft.
- R. Marshy areas and slopes, upper Biscante Canyon, Sec. 22, T22N, R24E; 5600-5800 ft.
- S. Lower Biscante Canyon to the Canadian River; Sec. 21, T22N, R24E; 5300-5600 ft.
- T. Upper Blanco Canyon, SE 1/4 Sec. 15, NE 1/4 Sec 22, T20N, R25E; 5600-5700 ft.
- U. Lower Blanco Canyon, Sec. 28,29, T20N, R26E; 5300-5500 ft.

- V. Rim top and grassland above Blanco Canyon, NW 1/4 Sec. 22, T20N, R25E; 5700 ft.
- W. East-west arm of Mestonito Canyon, NE 1/4 Sec. 2, T21N, R24E; 5400-5700 ft.
- X. Upper north-south arm of Mestonito Canyon, SW 1/4 Sec. 35, T22N, R24E, NW 1/4 Sec. 11, T21N, R24E; 5400-5700 ft.
- Y. Lower north-south arm of Mestoniton Canyon, SW 1/4 Sec. 2, NE 1/4 Sec. 11, T21N, R24E; 5100-5400 ft.
- Z. Grassland and rimrock above Mestonito Canyon, SE 1/4 Sec. 2, NE 1/4 Sec. 11, T21N, R24E; 5700 ft.
- AA. Casa Chiquita Canyon, S 1/2 Sec. 28, T22N, R24E; 5300-5700 ft.
- BB. Emplazado Canyon, spring, walls, and rim, Sec. 9, T20N, R25E; 5500-5800 ft.

Flora of the Canadian River Canyon

Annotated Check List

Aceraceae. Maple Family.

Acer negundo L. var. interius Western box elder. (D,E,H,R,Y)

Alismaceae. Water-plantain Family.

Alisma subcordata Raf. American water-plantain. (BB,R)

Alisma trivale Pursh. Common water-plantain. (J)

Sagittaria cuneata Sheld. Wapato. (E,M,R)

Sagittaria latifolia Willd. Duck-potato. (L)

Amaranthaceae. Amaranth Family.

*Amaranthus palmeri Wats. Carelessweed. (D)

*Amaranthus powellii Wats. Powell pigweed. (D)

*Froelichia gracilis (Hook.) Moq. (M,E)

Anacardiaceae. Sumac Family.

Rhus radicans L. Poison ivy. (A,B,E,I,P,Q,R,T,W,X)

Rhus trilobata Nutt. var. trilobata. Skunkbush. (B,D,N,O,
P,Q,R,S,Y)

Rhus trilobata var. pilosissima Engler. Hairy skunkbush.
(A,B,D,E,I,K,M,P,R)

Apocynaceae. Dogbane Family.

Apocynum cannabinum L. var. glaberrimum A. DC. Smooth
dogbane. (D)

Apocynum sibericum Jacq. var. salignum (Greene) Fern.
Northern dogbane. (P,R,T)

Apocynum suksdorfii Greene var. suksdorfii. Dogbane.
(R,S,T,U,W,X)

Apocynum suksdorfii var. angustifolia (Woot.) Woodson.
Narrowleaf dogbane. (A,I,K)

Asclepiadaceae. Milkweed Family.

Asclepias arenaria Torr. Sand milkweed. (K,X)

*Asclepias engelmanniana Woodson. Engelmann milkweed. (D)

Asclepias latifolia (Torr.) Raf. Broadleaf milkweed. (F,M,R)

Asclepias macrotis Torr. Shrubby milkweed. (D,F,M,P)

Asclepias speciosa Torr. Showy milkweed. (D)

Asclepias subverticillata (Gray) Vail. Poison milkweed.
(A,D,I,J,O,R)

- Asclepias verticillata L. Whorlleaf milkweed. (D,T)
Asclepias viridiflora Raf. Greenflower milkweed. (K)
 *Funastrum spp. Vining milkweed. (D)

Boraginaceae. Borage Family.

- Cryptantha jamesii (Torr.) Payson. James hiddenflower. (F)
Cryptantha minima Rydb. Dwarf hiddenflower. (J)
Cryptantha thyrsoiflora (Greene) Payson. Plains hiddenflower.
 (K,L,O,X)
Lappula redowskii (Hornem.) Greene. Redowski stickseed.
 (B,D,J,R,S,T)
Lithospermum incisum Lehm. Cleft-flowered puccoon.
Macromeria viridiflora DC. Marbleseed.
Onosmodium occidentale Mack. Western false gromwell. (D)

Cactaceae. Cactus Family.

- Coryphantha missouriensis (Sweet) Britt. & Rose. Missouri
 River pincushion. (K)
Coryphantha vivipara (Nutt.) Britt. & Rose var. vivipara.
 Red-spined pincushion. (A,D,F,J)
Echinocereus triglochidiatus Engelm. var. melanacanthus
 (Engelm.) L. Benson. Canyon claretcup. (A,C,E,I)
Echinocereus triglochidiatus var. neomexicanus (Standl.)
 Standl. ex W. T. Marshall. New Mexico claretcup. (U)
Echinocereus viridiflorus Engelm. var. viridiflorus
 Green pitaya. (F,G,I)
Mammillaria heyderi Muhlenpf. var. meiacantha (Engelm.)
 L. Benson. Heyder pincushion. (F,J,M,N,U,AA)
Opuntia imbricata (Haw.) DC. Plains cholla. (A,B,C,D,E,F,
 H,J,N,R,S,V,AA)
Opuntia phaeacantha Engelm. var. camanchica (Engelm. &
 Bigel.) L. Benson. Texas prickly pear. (C)
Opuntia polyacantha Haw. var. trichophora (Engelm & Bigel.)
 Coult. Hair-spined plains prickly pear. (Z,V)
Opuntia phaeacantha Engelm. var. phaeacantha. Plains
 prickly pear. (B,C,D,H,J,N,U)
Opuntia polyacantha Haw. var. polyacantha. Plains prickly
 pear. (C,F,I,K,M)

Campanulaceae. Bellflower Family.

Campanula rotundifolia L. Harebell. (D)

Capparidaceae. Caper Family.

Polanisia trachysperma Torr. & Gray. Stinking clover.
(Q,J)

Caryophyllaceae. Pink Family.

Arenaria fendleri Gray. Fendler sandwort. (X)

Paronychia sessiliflora Nutt. Nailwort. (K,L,O)

Silene antirrhina L. Sleepy catchfly. (X)

*Stellaria longipes Goldie var. laeta (Richards.) Wats.
Longstalk starwort. (M)

Characeae. Chara Family.

Chara canescens L. Chara. (D)

Chenopodiaceae. Goosefoot Family.

Atriplex canescens (Pursh) Nutt. Four-wing saltbush. (D,H,S)

Chenopodium album L. Lamb's quarters. (A,B,D,H,J)

*Chenopodium botrys L. Jerusalem oak. (M)

Chenopodium hians Standl. (E)

Chenopodium leptophyllum Nutt. Slimleaf goosefoot. (D,AA)

Chenopodium watsonii A. Nels. Watson goosefoot. (R,D)

Eurotia lanata (Pursh) Moq. Winterfat. (A,D,F,N)

Kochia scoparia (L.) Roth. Summer-cypress. (D,H)

Salsola kali L. var. tenuifolia Tausch. Russian thistle.
(D,H)

Suckleya suckleyana (Torr.) Rydb. Poison suckleya. (F)

Commelinaceae. Spiderwort Family.

Commelina erecta L. var. angustifolia (Michx.) Fern.
Hairy-bracted dayflower. (R,T,P)

Tradescantia pinetorum Greene. Forest spiderwort. (R)

Tradescantia occidentalis (Britt.) Smyth var. occidentalis
Western spiderwort. (R,T)

Tradescantia spp. Spiderwort. (I,P)

Compositae. Aster Family.

Ambrosia artemisiifolia L. Common ragweed. (D)

*Antennaria spp. Pussytoes. (P)

Arnica latifolia Bong. Broadleaf arnica. (L,D)

Artemisia bigelovii Gray. Bigelow sagebrush. (K,L,O)

Artemisia dracunculoides Pursh. False tarragon. (Q,P)

Artemisia filifolia Torr. Sand sagebrush. (A,D,H,Q)

Artemisia frigida Willd. Estafiata. (A,D,F,K,Z)

Artemisia ludoviciana Nutt. Wormwood. (B,D,E,I,Q,R,X)

Artemisia caruthii Wood. Flat sagebrush. (F)

*Aster ericoides L. White-rayed aster. (P)

Aster fendleri Gray. Fendler aster. (L,K)

Aster horridus (Woot. & Standl.) Blake. Spiny-toothed aster. (E,J,P,R,S,W)

Aster porteri Gray. Porter aster. (J,P,E,G,I)

Baccharis glutinosa Pers. Sticky baccharis. (E)

Baccharis pteronoides DC. Yerba-de-pasmo. (C,E,G,I)

Baccharis wrightii Gray. Wright baccharis. (C,G,I)

Bahia neomexicana Gray. New Mexico bahia. (C,D,E,P)

Bahia oppositifolia (Nutt.) DC. Plains bahia. (K)

Bahia woodhousei Gray. Woods bahia. (C,F)

*Baileya multiradiata Harv. & Gray. Desert marigold. (P)

Berlandiera lyrata Benth. Lyreleaf berlandiera. (K,F,X)

*Brickellia brachyphylla Gray. Lanceleaf brickelbush. (K,P)

Brickellia californica (Torr. & Gray) Gray. California brickelbush. (A,B,D,E,H,Q,R,W,BB)

Brickellia floribunda Gray. Bigleaf brickelbush. (B,P,D)

Chrysopsis canescens (DC.) Torr. & Gray. Silvery golden-aster. (P)

Chrysopsis villosa (Pursh) Nutt. ex DC. Hairy golden-aster. (B,D,Q,R,S)

Chrysopsis viscida (Gray) Cronquist. Viscid golden-aster. (A,B,D,E,G,I)

Chrysothamnus nauseosus (Pallas) Britt. subsp. graveolens (Nutt.) H. & C. Rubber rabbitbrush. (D,E)

Cichorium intybus L. Chicory. (T)

Cirsium ochrocentrum Gray. Santa Fe thistle. (K,L)

Cirsium undulatum (Nutt.) Spreng. Wavyleaf thistle.
(B,C,D,E,J,M,R)

Conyza canadensis (L.) Cronq. Canada conyza. (I,J,R,S,T,U)

Dyssodia papposa (Vent.) Hitchc. Fetid marigold. (E,F,J,K)

Engelmannia pinnatifida Torr. & Gray. Engelmann daisy.
(A,C,D,F,J,K,S,U,Y)

Erigeron canus Gray. Hoary fleabane. (F,K,L)

Erigeron divergens Torr. & Gray. Spreading fleabane. (G)

Erigeron flagellaris Gray. Trailing fleabane. (J)

Erigeron neomexicanus Gray. New Mexico fleabane. (J)

Erigeron nudiflorus Buckl. Sprawling fleabane. (L)

*Eupatorium herbaceum (Gray) Greene. Desert thoroughwort.
(P,E)

Eupatorium wrightii Gray. Spreading thoroughwort. (Q)

*Franseria acanthicarpa Hook. & Cov. Burweed. (D,R,W)

Franseria confertiflora (DC.) Rydb. Slimleaf burweed. (A,K)

Gnaphalium spp. Everlasting. (B,E,I)

Grindelia aphanactis Rydb. Plains gumweed. (B)

Grindelia squarrosa (Pursh) Dunal. Curlycup. (F)

Gutierrezia sarothrae (Pursh) Britt. & Rusby. Plains
snakeweed. (A,C,E,F,J,K,O,P,V,Z)

Haplopappus spinulosus (Pursh) DC. subsp. spinulosus
Spinyleaf goldenweed. (D,F,K,L)

Haplopappus spinulosus subsp. australis (Greene) Hall.
Southern spinyleaf goldenweed. (D,U)

Haplopappus spinulosus subsp. glaberrimus (Rydb.) Hall.
Smooth spinyleaf goldenweed. (D,Y)

Helianthus annuus L. Annual sunflower. (A,D,F,R,T)

Helianthus ciliaris L. Blueweed. (T)

Helianthus nuttallii Torr. & Gray. Nuttall sunflower. (W)

Helianthus petiolaris Nutt. Prairie sunflower. (D,R,S,U,W)

*Heterosperma pinnatum Cav. (P)

Heterotheca horrida (Rydb.) Harms. Rough golden-aster.
(Q)

*Hieracium spp. Hawkweed. (P)

Hymenopappus filifolius Hook. var. cinereus (Rydb.) Johnst.
Threadleaf white ragweed. (K)

Hymenopappus flavescens Gray var. cano-tomentosus Gray
Silvery white ragweed. (C,K,Q,V)

Hymenopappus tenuifolius Pursh. Plains white ragweed.
(C,F,P)

Hymenoxys acaulis (Pursh) Parker var. arizonica (Greene)
Parker. Rubberweed. (D,J,K,L,O,Z)

Hymenoxys scaposa (DC.) Parker var. scaposa. Rubberweed.
(A,O)

Hymenoxys scaposa var. linearis (Nutt.) Parker. Narrowleaf
rubberweed. (K)

Iva axillaris Pursh. Poverty sumpweed. (G,J)

*Iva xanthifolia Nutt. Clotbur. (D)

Kuhnia chlorolepis Woot. & Standl. False boneset. (I,D)

Lactuca serriola L. var. serriola. Wild lettuce. (B,D,H,J)

Leucelene ericoides (Torr.) Greene. Dwarf aster. (K)

Liatris punctata Hook. Gayfeather. (D,K,M,P)

Lygodesmia juncea (Pursh) D. Don. Rushstem skeletonplant.
(D)

*Machaeranthera tanacetifolia (H.B.K.) Nees. Tansyleaf
aster. (D)

Melampodium leucanthum Torr. & Gray. Blackfoot. (C,D,I,K,L,Z)

*Parthenium incanum H.B.K. Mariola. (D)

Pericome caudata Gray. Arrowleaf. (B,D,E,Q,R)

Psilostrophe sparsiflora (Gray) A. Nels. Greenstem paper-
flower. (D)

Psilostrophe tagetina (Nutt.) Greene var. grandiflora (Rydb.)
Heiser. Rydberg paperflower. (A,D,O)

Ratibida columnifera (Nutt.) Woot. & Standl. f. columnifera
Prairie coneflower. (A,B,D,J,R,T)

Ratibida tagetes (Jones) Barnh. Globehead coneflower.
(B,D,F,J,R)

Senecio canus Hook. Silvery groundsel. (K)

Senecio douglasii DC. var. longilobus (Benth.) L. Benson
Threadleaf groundsel. (C,D,F,H,J,P)

Senecio douglasii var. monoensis (Greene) Jeps. Douglas
groundsel. (M,K) = S. douglasii var. douglasii.

Senecio fendleri Gray. Notchleaf groundsel. (K)

Senecio spp. Groundsel. (P)

*Solidago missouriensis Nutt. Missouri goldenrod. (P)

Solidago sparsiflora Gray. Goldenrod. (E,P,Q,W)

Solidago wrightii Gray. Wright goldenrod. (E,G,I,P,W)

Sonchus asper (L.) Hill. Prickly sow thistle. (E)

Stephanomeria pauciflora (Torr.) A. Nels. Wire-lettuce.
(A,D,F)

*Tagetes micrantha Cav. Wild marigold. (E)

Taraxacum officinale Weber. Common dandelion. (E,I,P,R,W)

Thelesperma longipes Gray. Cota. (T)

Thelesperma megapotamicum (Spreng.) O. Ktze. Navaho tea.
(B,C,D,E,F,K)

Thelesperma subnudum Gray. Navaho tea. (K)

Townsendia excapa (Richards.) Porter. Dwarf Townsend aster.
(K,L,O)

Townsendia grandiflora Nutt. Dwarf Townsend aster. (K)

Tragopogon pratensis L. Salsify. (D,E,I)

*Verbesina encelioides (Cav.) Benth. & Hook. (D,K)

Xanthium strumarium L. var. canadense (Mill.) Torr. & Gray.
(D,F,I,J)

Xanthium spp. (D)

Zinnia grandiflora Nutt. (F,H,J,K,L,Z)

Convolvulaceae. Morning-glory Family.

Convolvulus arvensis L. Bindweed. (U)

Convolvulus incanus Vahl. Climbing bindweed. (D,F,J)

Evolvulus nuttallianus R. & S. Small-flowered morning
glory. (L)

Evolvulus sericeus Sw. var. sericeus. Silvery morning
glory. (I)

*Ipomoea hederacea (L.) Jacq. Ivyleaf morning glory. (E)

*Ipomoea hirsutula Jacq. Hairy morning glory. (D)

Ipomoea leptophylla Torr. Shrubby morning glory. (A,D)

Cruciferae. Mustard Family.

Camelina microcarpa Andrz. Littleseed false flax. (BB)

Draba brachycarpa Nutt. Twistpod. (P)

Draba helleriana Greene. Mountain twistpod. (D)

Lepidium densiflorum Schrad. Many-flowered peppergrass.
(E,G)

Lesquerella intermedia (Wats.) Heller. Bladderpod. (K)

Lesquerella ovalifolia Rydb. Ovalleaf bladderpod. (Q)

Sisymbrium linearifolium (Gray) Payson. Narrow-leaves
tumble-mustard. (I,J,M)

Streptanthella longirostris (Wats.) Rydb. (C)

Thelypodium longifolium (Benth.) Wats. Narrow-leaved
thelypodium. (J)

Thelypodium wrightii Gray. Wright thelypodium. (E,I,J)

Cucurbitaceae. Melon Family.

Cucurbita foetidissima H.B.K. Buffalo gourd. (D,F,H,I,J)

Cupressaceae. Cypress Family.

Juniperus monosperma (Engelm.) Sarg. One-seed juniper.
(A,B,C,D,E,F,G,H,I,J,K,M,N,P,Q,R,S,T,U,V,X,Y,Z,AA)

Juniperus scopulorum Sarg. Rocky Mountain juniper.
(A,B,D,E,G,I,J,M,P,Q,R,T,W,X,BB)

Juniperus X scopulorum. Hybrid. (B,D)

Cyperaceae. Sedge Family.

Carex brevior (Dewey) Mack. Short-beaked meadow sedge.
(G,I)

Carex foena Willd. Alpine sedge. (Q)

Carex hystricina Muhl. Porcupine sedge. (P)

Carex vulpinoidea Michx. Foxtail sedge. (B,E,P,R,X)

Carex xerantica Bailey. Stiff sedge. (Q)

*Cyperus aristatus Rotth. Spiny sedge. (E)

Cyperus fendlerianus Boeckl. Fendler flat sedge. (E,P,R,T,X)

Eleocharis macrostachya Britt. Pale spike rush. (B,E,M)

Scirpus acutus Muhl. Tule. (H,P,BB)

Scirpus americanus Pers. var. longispicatus Britt.

Longspike three-square. (D,E,R)

Scirpus atrovirens Willd. var. pallidus Britt. Pale bulrush. (E,I,P,R,BB)

Scirpus olneyi Gray. Olney bulrush. (P,R,X)

Ephedraceae. Joint-fir Family.

Ephedra torreyana Wats. Torrey joint-fir. (I)

Equisetaceae. Horsetail Family.

Equisetum arvense L. Common horsetail. (D,P,R,T,W)

Equisetum laevigatum A. Br. Smooth horsetail. (D)

Equisetum hiemale L. var. affine (Engelm.) A. A. Eaton.

Scouring rush. (D)

Euphorbiaceae. Spurge Family.

*Croton pottsii (Klotzch) Muell. Arg. Leatherweed. (D)

*Euphorbia dentata Michx. Toothed spurge. (D,E)

Euphorbia geyeri Engelm. Geyer spurge. (L)

Euphorbia glyptosperma Engelm. Ridgeseed spurge. (F)

Euphorbia maculata L. Spotted spurge. (R,T)

Euphorbia marginata Pursh. Mountain snow. (D,F,J,L,M,R,T,U)

Euphorbia micromeria Boiss. Ground spurge. (T)

Euphorbia robusta (Engelm.) Small. Big Jane. (D,K,N)

Euphorbia serpyllifolia Pers. Littleleaf ground spurge.

(D,G,T)

Tragia nepetaefolia Cav. Plains noseburn. (B,E,J)

Tragia stylaris Muell. Arg. Rock noseburn. (B,D,S,Y)

Fagaceae. Oak Family.

Quercus gambelii Nutt. Gambel oak. (P,S,T,AA)

Quercus X gambelii (hybrid). (A,E,P)

- *Quercus havardii Rydb. Havard shinoak. (E)
- Quercus pungens Liebm. Sandpaper oak. (B,D,P)
- Quercus grisea Liebm. Gray oak. (A,B,D,G,H,J,P,Q,R,T,U,W)
- Quercus rugosa Nee. Reticulate oak. (E)
- Quercus undulata Torr. Wavyleaf oak. (A,B,C,E,F,I,J,P,Q,R,
T,U,W,BB)

Geraniaceae. Geranium Family.

- Erodium cicutarium (L.) L'Her. Filaree. (D,AA)

Gramineae. Grass Family.

- Agropyron inerme Rydb. Awnless wheatgrass. (D,T)
- Agropyron smithii Rydb. Western wheatgrass. (H,M)
- Agrostis exarata Trin. Spike bent. (E)
- Agrostis semiverticillata (Forsk.) C. Chr. Water bent.
(D,E,P,R,X)
- *Andropogon gerardii Vitman. Big bluestem. (K,P)
- Andropogon saccharoides Swartz. Silver beardgrass. (A,B,D,
E,I,M)
- Andropogon scoparius Michx. Little bluestem. (A,B,E,G,J,K,
P,Q,S,U,Y)
- Aristida arizonica Vasey. Arizona three-awn. (A,E,M)
- Aristida divaricata Humb. & Bonpl. Poverty three-awn. (E,M,
P,S)
- Aristida fendleriana Steud. Fendler three-awn. (D,Q)
- Aristida longiseta Steud. Red three-awn. (J,K,P,V)
- Aristida purpurea Nutt. Purple three-awn. (B,D,E,K,L,P,S)
- Bouteloua curtipendula (Michx.) Torr. Sideoats grama.
(A,B,C,D,E,G,H,I,J,K,L,P,Q,R,S,T,U,W,X,Y)
- Bouteloua eriopoda Torr. Black grama. (B,D,Q)
- Bouteloua gracilis (H.B.K.) Lag. Blue grama. (A,C,D,E,F,
H,K,L,M,O,P,Q,V,Z,AA)
- Bouteloua hirsuta Lag. Hairy grama. (D,E,K,M,P)
- Bromus anomalus Rupr. Nodding brome. (E)
- Bromus frondosus (Shear) Woot. & Standl. Weeping brome. (R)
- Bromus lanatipes (Shear) Rydb. Nodding brome. (B,E,H)

- Buchloe dactyloides (Nutt.) Engelm. Buffalograss. (C,D,F,L,Q)
- * Cenchrus insertus M. A. Curtis. Sandbur. (D)
- * Chloris virgata Sw. Feather fingergrass. (D)
- Dactylis glomerata L. Orchard grass. (D)
- Dicanthelium oligosanthos (Schult.) Gould var. scribnerianum (Nash) Gould. Scribner dicanthelium. (Q,I)
- Distichlis stricta (Torr.) Rydb. Saltgrass. (D,L)
- * Echinochloa crusgalli (L.) Beauv. Barnyard grass. (P)
- Elymus canadensis L. Canada wild rye. (A,B,D,E,G,I,P,Q,R,T)
- * Eragrostis cilianensis (All.) Link. Stink grass. (D)
- Eragrostis intermedia Hitchc. Plains lovegrass. (E,G,I)
- * Eragrostis spectabilis (Pursh) Steud. Purple lovegrass. (P)
- * Festuca elatior L. Meadow fescue. (E)
- Festuca octoflora Walt. Six-weeks fescue. (E)
- Hilaria jamesii (Torr.) Benth. Galleta. (A,B,C,E,F,K,L,M,P,R,S,T,U,X,Y)
- Hordeum jubatum L. Foxtail barley. (D,P)
- Koeleria cristata (L.) Pers. Junegrass. (E,P)
- * Leptochloa dubia (H.B.K.) Nees. Greene sprangletop. (D)
- Lycurus phleoides H.B.K. Wolftail. (B,D,E,G,K,M,P,Q)
- * Muhlenbergia cuspidata (Torr.) Rydb. Plains muhly. (K)
- * Muhlenbergia mexicana (L.) Trin. Mexican dropseed. (E)
- * Muhlenbergia minutissima (Steud.) Swallen. Least muhly. (E)
- * Muhlenbergia montana (Nutt.) Hitchc. Mountain muhly. (E,P)
- Muhlenbergia pauciflora Buckl. New Mexico muhly. (B,J)
- Muhlenbergia racemosa (Michx.) B.S.P. Greene muhly. (E,Q)
- Muhlenbergia rigens (Benth.) Hitchc. Deergrass. (E,G,I,P)
- Muhlenbergia torreyi (Kunth) Hitchc. Ring muhly. (C,D,F,M)
- * Muhlenbergia wrightii Vasey. Spike muhly. (P)
- Munroa squarrosa (Nutt.) Torr. False buffalograss. (C,N)
- Oryzopsis hymenoides (R. & S.) Ricker. Indian ricegrass. (D,H,U)

Oryzopsis micrantha (Trin. & Rupr.) Thurb. Littleseed ricegrass. (Q)

Panicum bulbosum H.B.K. Bulb panicum. (E,I)

Panicum obtusum H.B.K. Vine mesquite. (B,D,E,K,Q,R,Y)

Panicum virgatum L. Switchgrass. (A,D,E,J,N,P,BB)

Phleum pratense L. Timothy. (D,E,R)

Phragmites communis Trin. Common reed. (R)

Poa compressa L. Canada bluegrass. (B,E,Q)

Poa pratensis L. Kentucky bluegrass. (D,E)

Polypogon monspeliensis (L.) Desf. Rabbitfoot grass. (D,E,J,Q,T)

Schedonnardus paniculatus (Nutt.) Trel. Tumblegrass. (D,J,K,P)

*Scleropogon brevifolius Phil. Burrograss. (C)

*Setaria lutescens (Wiegel) Hubbard. Yellow bristlegrass. (E)

*Setaria macrostachya H.B.K. Plains bristlegrass. (D)

*Sorghastrum nutans (L.) Nash. Indian grass. (D,E,P)

Sphenopholis obtusata (Michx.) Scribn. Wedgegrass. (A,J)

Sitanion hystrix (Nutt.) J. G. Smith. Squirreltail. (D,N)

*Sporobolus cryptandrus (Torr.) Gray. Sand dropseed. (D)

Sporobolus airoides Torr. Alkali sacaton. (D,I,K,L)

Sporobolus flexuosus (Thurb.) Rydb. Mesa dropseed. (H,K)

*Sporobolus nealleyi Vasey. Nealley dropseed. (M)

Stipa neomexicana (Thurb.) Scribn. New Mexico porcupine grass. (K)

Tridens pilosus (Buckl.) Hitchc. Hairy tridens. (C,M,P,Z)

Tridens pulchellus (H.B.K.) Hitchc. Fluffgrass. (C,J)

Haloragaceae. Water-milfoil Family.

Myriophyllum pinnatum (Walt.) B.S.P. Spiked water-milfoil. (L)

Juglandaceae. Walnut Family.

Carya illinoensis (Wang.) K. Koch. Pecan. (D)

Juglans microcarpa Berl. Little walnut. (D)

Juncaceae. Rush Family.

Juncus balticus Willd. var. montanus Engelm. Wirerush. (R,X)

Juncus interior Wieg. var. interior. Inland rush. (B,D,E,G)
P,Q,R,T,X)

Juncus interior var. arizonicus (Wieg.) Hermann. Arizona
inland rush. (BB)

Juncus saximontanus A. Nels. Rock rush. (D)

Labiatae. Mint Family.

Hedeoma drummondii Benth. Drummond false pennyroyal. (L)

Lycopus americanus Muhl. American bugleweed. (X)

*Marrubium vulgare L. Horehound. (M)

Mentha arvensis L. Field mint. (R)

*Salvia reflexa Hornem. Rocky Mountain sage. (D,K)

Teucrium laciniatum Torr. Cutleaf germander. (J,K)

Leguminosae. Legume Family.

Amorpha canescens Pursh. Leadplant amorphia. (B,C,G,I,P)

Astragalus flexuosus Dougl. Sprawling milkvetch. (J)

Astragalus lotiflorus Hook. Lotus-flowered milkvetch. (?)

Astragalus wittmanii Barneby. Wittman milkvetch. (K,L,O)

Dalea aurea Nutt. Silktop indigobush. (C,D)

Dalea enneandra Nutt. Plains indigobush. (A,B,D)

Dalea formosa Torr. Feather indigobush. (A,Q)

*Dalea jamesii (Torr.) Torr. & Gray. James indigobush. (D)

Desmanthus cooleyi (Eaton) Trel. Cooley bundleflower. (A,D)

*Gleditzia triacanthos L. Honey locust. (D)

Glycyrrhiza lepidota (Nutt.) Pursh. Licorice. (A,J)

Hedysarum boreale Nutt. Sweet vetch. (O)

Hoffmanseggia drepanocarpa Gray. Rushpea. (K)

Hoffmanseggia jamesii Torr. & Gray. James rushpea. (I,J)

Lathyrus eucosmus Butters & St. John. Bush peavine. (A,O)

Lupinus kingii Wats. Kingston. (H)

*Medicago sativa L. Alfalfa. (D)

Melilotus albus Desr. White sweetclover. (A,J,P,R)

Melilotus officinalis (L.) Lam. Yellow sweetclover. (D,J,R,T)

Oxytropis lambertii Pursh var. bigelovii Gray. Bigelow
locoweed. (D,J,Q)

Oxytropis sericea Nutt. Silverleaf locoweed. (K,Y)

Petalostemum candidum (Willd.) Michx. White prairie clover. (D,J)

Petalostemum multiflorum Nutt. Globehead prairie clover. (D)

Petalostemum purpureum (Vent.) Rydb. Purple prairie clover. (E,H,K,O)

Prosopis glandulosa Torr. var. torreyana (L. Benson) M. C. Johnst. Mesquite. (B,C,I,J,Z)

Psoralea tenuiflora Pursh var. tenuiflora. Slender scurf pea. (D,K,P)

Psoralea tenuiflora var. bigelovii (Rydb.) Macbr. Bigelow scurf pea. (C,F,H)

Robinia pseudoacacia L. Black locust. (D)

Sophora nuttalliana B. L. Turner. Nuttall sophora. (A,D,E,I,J)

Trifolium dasyphyllum Torr. & Gray. Alpine clover. (D,P,R)

Vicia exigua Nutt. Slim vetch. (U)

Vicia ludoviciana Nutt. Deer vetch. (B,E)

Liliaceae. Lily Family.

*Allium cernuum Roth. Nodding onion. (P)

Asparagus officinalis L. Asparagus. (D,E)

Nolina microcarpa Wats. Beargrass. (B,E,I,J,N,V,AA)

Yucca baccata Torr. Banana yucca. (B,E,I,N,R,T,U,X,AA)

Yucca glauca Nutt. Soapweed yucca. (A,D,E,H,K,L,M,O,P,V,Z)

Yucca neomexicana Woot. & Standl. New Mexico yucca. (I,J,N,P)

Linaceae. Flax Family.

Linum lewisii Pursh. Western blue flax. (K,L,P)

Loasaceae. Loasa Family.

Mentzelia decapetala (Pursh) Urb. & Gilg. (D)

Mentzelia pumila var. multiflora (Nutt.) Gray. Golden blazing star. (K,L,O)

Loranthaceae. Mistletoe Family.

Phoradendron juniperinum Engelm. Juniper mistletoe. (N)

Malvaceae. Mallow Family.

Sphaeralcea coccinea (Pursh) Rydb. Globe mallow. (?)

Sphaeralcea fendleri Gray. Fendler globe mallow. (D)

Sphaeralcea digitata (Greene) Rydb. Digitate globe mallow.
(D,F,K,L,P)

Marsileaceae. Water-fern Family.

Marsilea mucronata A. Br. Water-fern. (L)

Martyniaceae. Unicorn-plant Family.

*Proboscidea parviflora (Woot.) Woot. & Standl. Devil'sclaw.
(M)

Moraceae. Mulberry Family.

Maclura pomifera (Raf.) Schneid. Osage-orange. (D)

Morus alba L.?? White mulberry. (D)

Morus microphylla Buckl. Desert mulberry. (D,I)

Morus rubra L. Red mulberry. (D)

Najadaceae. Pondweed Family.

Potamogeton crispus L. Curleaf pondweed. (R)

Potamogeton diversifolius Raf. Rafinesque pondweed. (B,I,M,P,
BB)

Zannichellia palustris L. Horned pondweed. (E,P)

Nyctaginaceae. Four-o'clock Family.

Mirabilis multiflora (Torr.) Gray. Silvestre four-o'clock.
(T,I)

Oxybaphus albidus (Walt.) Choisy. Whitestem desert four-
o'clock. (H)

Oxybaphus linearis (Pursh) Robins. Narrow-leaved four-o-
clock. (J,L,Q,R,X)

*Oxybaphus pumilus (Standl.) Standl. Standley four-o-
clock. (D)

Oleaceae. Olive Family.

Forestiera neomexicana Gray. New Mexico olive. (A,B,D,E,
G,I,J,P,Q,T,U)

Onagraceae. Evening-primrose Family.

*Calylophus hartwegii Benth. subsp. lavandulaefolius (Torr. & Gray) Towner & Raven. Grayleaf calylophus. (K)

Gaura coccinea Nutt. Scarlet gaura. (D,F)

Gaura parviflora Dougl. Plains gaura. (D,R)

*Oenothera caespitosa Nutt. Tufted evening primrose. (M)

Oenothera hookeri Torr. & Gray. Late primrose. (D,H)

Orchidaceae. Orchid Family.

Epipactis gigantea Dougl. Giant helleborine. (X)

Orobanchaceae. Orobanche Family.

Orobanche multiflora Nutt.?? Broomrape. (D)

Oxalidaceae. Oxalis Family.

Oxalis albicans H.B.K. Southern wood sorrel. (R)

Oxalis stricta L. Yellow wood sorrel. (I)

Oxalis spp. Wood sorrel. (D)

Papaveraceae. Poppy Family.

Argemone spp. Prickly poppy. (H)

Pinaceae. Pine Family.

Pinus edulis Engelm. Colorado pinyon pine. (A,B,C,D,E,F, I,J,N,P,Q,R,S,T,U,W,X,Z,AA,BB)

Pinus ponderosa Laws. var. scopulorum Engelm. Ponderosa pine. (A,B,E,G,I,J,M,P,Q,R,T,W,Y,AA,BB)

Plantaginaceae. Plantain Family.

Plantago major L. Rippleseed plantain. (D,E,T)

Plantago purshii R. & S. Woolly Indian-wheat. (E,N,X)

Polemoniaceae. Phlox Family.

Gilia spp. Gilia. (F)

Ipomopsis aggregata (Pursh) V. Grant. Red rocket. (J)

Ipomopsis spicata (Nutt.) Grant. Spike gilias. (K)

Polemonium foliosissimum Gray var. molle (Greene) Anway Jacob's ladder. (D)

Polygonaceae. Knotweed Family.

- *Eriogonum alatum Torr. Winged wild buckwheat. (E)
- Eriogonum jamesii Benth. var. jamesii. Shrubby wild buckwheat. (F,K,O)
- Eriogonum jamesii var. undulatum (Benth.) S. Stokes.
Undulate-leaved wild buckwheat. (D,K,V,Z)
- Eriogonum lachnogynum Torr. Plains wild buckwheat. (K,O)
- Eriogonum tenellum Torr. Slender wild buckwheat. (C,G,I,L,P)
- Polygonum aviculare L. Knotweed. (D,E,I,J,R)
- Polygonum incarnatum Ell. Knotweed. (D)
- Polygonum lapathifolium L. Dock-leaved knotweed. (D,R)
- Polygonum persicaria L. Smartweed. (I)
- Rumex acetosella L. Sheep sorrel. (P)
- Rumex crispus L. Curly dock. (A,D,G,P,R,W)
- Rumex occidentalis Wats. Western dock. (I)

Polygalaceae. Milkwort Family.

- *Polygala alba Nutt. White milkwort. (K)

Polypodiaceae. Polypody Family.

- Asplenium septentrionale (L.) Hoffm. Green spleenwort.
(B,I,P,R,T,X)
- Asplenium trichomanes L. Maidenhair spleenwort. (R)
- Cheilanthes feei Moore. Fee lipfern. (R,X)
- Cheilanthes fendleri Hook. Fendler lipfern. (E,I,R)
- Cheilanthes tomentosa Link. Woolly lipfern. (E,W,X,AA)
- Cheilanthes villosa Davenp. ex Maxon. Hairy lipfern. (B,R)
- Cheilanthes wootonii Maxon. Beaded lipfern. (B,I,R,BB)
- Notholaena standley Maxon. Standley cloakfern. (E,I,P)
- Pellaea atropurpurea L. Purple cliffbrake. (R)
- Pityrogramma triangularis (Kaulf.) Maxon. Goldfern. (B,P,R,
S,X)
- Woodsia mexicana Fee. Mexican woodsia. (E,I)
- Woodsia oregana (DC.) Eaton. Oregon woodsia. (R)
- Woodsia plummerae Lemmon. Plummer woodsia. (W)
- Woodsia scopulina (DC.) Eaton. Rocky Mountain woodsia. (T)

Pontederiaceae. Pickerelweed Family.

Heteranthera limosa (Sw.) Willd. Water stargrass (I)

Portulacaceae. Purslane Family.

Portulaca oleracea L. Common purslane. (D,V)

Portulaca parvula Gray. Field purslane. (D)

Talinum parviflorum Nutt. Small-flowered talinum. (X)

Talinum pulchellum Woot. & Standl. Fameflower. (L)

Talinum spp. (?)

Ranunculaceae. Buttercup Family.

Clematis ligusticifolia Nutt. Western clematis. (H)

Ranunculus cymbalaria Pursh var. saximontanus Fern.

Desert crowfoot. (D,E,R,T,X)

Rosaceae. Rose Family.

Cercocarpus montanus Raf. var. montanus. Mountain mahogany.
(A,B,J,N,P,R,S,T,U,V,Z)

Cercocarpus montanus var. argenteus (Rydb.) F. L. Martin??

Fallugia paradoxa (D. Don) Endl. Apache plume. (A,D,J,Q)

Physocarpus monogynus (Torr.) Coult. Ninebark. (B)

Potentilla pulcherrima Lehm. Meadow cinquefoil. (D,P?)

Prunus americana Marsh. Wild plum. (P)

Prunus armeniaca L. Apricot. (D)

Prunus domestica L. Plum. (D)

Prunus serotina Ehrh. subsp. virens (Woot. & Standl.)
McVaugh. Southwestern chokecherry. (A,E,G,I)

Prunus virginiana L. var. melanocarpa (A. Nels.) Sarg.
Western black chokecherry. (D,P,R,S,T,W)

Pyrus communis L. Pear. (D)

Pyrus malus L. Apple. (D,P)

Rosa woodsii Lindl. var. woodsii. Woods rose. (D,I)

Rosa woodsii var. macounii (Greene) Martin & Hutchins. (D,I)

Rubus neomexicanus Gray. New Mexico raspberry. (P)

Rutaceae. Citrus Family.

Ptelea trifoliata L. subsp. polydenia (Greene) V. L.

Bailey. Wafer ash. (A,D,E,H,P,Q,S,V,W,Y,BB)

Populus angustifolia James. Narrow-leaved cottonwood.
(R,W,X,V,Y,P)

Populus fremontii Wats. Plains cottonwood. (D,E,Q,P,G,J)

Populus tremuloides Michx. var. aurea (Tidestr.) Daniels
Trembling aspen. (I,P)

Populus X acuminata Rydb. Pointleaf cottonwood. (B,E,J)

*Salix amygdaloides Anderss. Peachleaf willow. (E)

Salix caudata (Nutt.) Heller. Whiplash willow. (D)

Salix exigua Nutt. var. exigua. Coyote willow, (A,D,E,J,P,BB)

Salix exigua var. stenophylla (Rydb.) Schneid, Slenderleaf
coyote willow. (P,R,W,X)

Salix lasiandra Benth. Shining willow. (D,E)

Salix nigra Marsh. Black willow. (I)

Santalaceae. Sandalwood Family.

Comandra pallida A. DC. Bastard toadflax. (E)

Sapindaceae. Soapberry Family.

Sapindus saponaria L. var. drummondii (Hook. & Arn.) .
L. Benson. Drummond soapberry. (H)

Saxifragaceae. Saxifrage Family.

Ribes inebrians Lindl. Squaw currant. (L)

Ribes inerme Rydb. Whitestem gooseberry. (B,Q)

Ribes montigenum McClelland. Gooseberry currant. (L,R,W)

Ribes pinetorum Greene. Orange gooseberry. (Q)

Scrophulariaceae. Figwort Family.

Castilleja integra Gray. Common paintbrush. (A,E,J)

*Linaria vulgaris Mill. Butter-and-eggs. (O)

Penstemon barbatus (Cav.) Roth subsp. barbatus. Beardlip
penstemon. (?)

Penstemon barbatus subsp. torreyi (Benth.) Keck. Torrey
penstemon. (B,E,G,Q,S)

Penstemon fendleri Torr. & Gray. Fendler beardtongue. (K)

Penstemon secundiflorus Benth. Sideflowered beardtongue. (L)

Penstemon spp. Beardtongue. (O)

Verbascum thapsus L. Mullein. (B,E,I,P,Q,R,U,S,T,Y)

Veronica peregrina L. var. xalapensis (H.B.K.) Pennell.
Mexican speedwell. (E,I)

Selaginellaceae. Spikemoss Family.

Selaginella underwoodii Hieron. Desert spikemoss. (E,I,P,R,
X,BB)

Simaroubaceae. Simarouba Family.

Ailanthus altissima (Mill.) Swingle. Tree-of-Heaven. (D,BB)

Solanaceae. Nightshade Family.

Chamaesaracha conioides (Moric.) Britt. (K,P)

Chamaesaracha crenata Rydb. (O)

*Datura quercifolia H.B.K. Oak-leaved thornapple. (D)

Lycium pallidum Miers. Pale wolfberry. (A,C,D,Z)

Physalis foetens Poir. var. neomexicana (Rydb.) Waterfall.
New Mexico groundcherry. (F)

Physalis hederæfolia Gray. Sand groundcherry. (D)

Physalis ixocarpa Brot. Groundcherry. (R)

Physalis lobata Torr. Lobeleaf groundcherry. (K,O)

Physalis virginiana Mill. var. sonorae (Torr.) Waterfall.
Sonoran groundcherry. (D)

Physalis virginiana var. subglabrata (Mack. & Bush) Water-
fall. Smooth groundcherry. (R)

Physalis wrightii Gray. Wright groundcherry. (S)

Solanum elaeagnifolium Cav. Horse-nettle. (X)

Solanum rostratum Dunal. Buffalobur. (D,R,T,U,X)

*Solanum americanum Mill. Common nightshade. (M)

Solanum triflorum Nutt. Cutleaf nightshade. (?)

Tamaricaceae. Tamarisk Family.

Tamarix pentandra Pall. Tamarisk. (A,D,H,J,Q,R)

Typhaceae. Cattail Family.

Typha angustifolia L. Narrowleaf cattail. (J,R,W,X,BB)

Ulmaceae. Elm Family.

Celtis occidentalis L. Hackberry. (D)

Celtis reticulata Torr. Netleaf hackberry. (A,D)

Ulmus americana L. American elm. (H)

Ulmus pumila L. Chinese elm. (D)

Umbelliferae. Carrot Family.

Berula erecta (Huds.) Cov. Water parsnip. (P,W,X)

Harbouria trachypleura (Gray) Coult. & Rose. (K,R)

Urticaceae. Nettle Family.

Urtica gracilis Ait. Common nettle. (T)

Verbenaceae. Vervain Family.

Phyla cuneifolia (Torr.) Greene. Wedgeleaf phyla. (D)

Phyla incisa Small. Cutleaf phyla. (D)

Verbena bipinnatifida Nutt. Plains vervain. (E,I)

Verbena bracteata Lag. & Rodr. Bigbract vervain. (A,B,D,E,J
P,Q)

Verbena plicata Greene. Vervain. (F)

Vitaceae. Grape Family.

Parthenocissus insertus (Kerner) K. Fritsch. Western
creeper. (A,B,D,E,P,Q,R,S,T,U,W,X,Y,BB)

Vitis arizonica Engelm. Canyon grape. D,I,P,Q,R,T,W,X)

Vitis longii Prince. Long grape. (A,B,D,E,P,R,BB)

Zygophyllaceae. Goathead Family.

* Kallstroemia parvifolia Norton. Small-flowered caltrop.
(D)

* Tribulus terrestris L. Goathead. (D)

Synopsis of Fall Survey
September 1981

Martin and Fletcher revisited the study area on September 17 and 18, 1981. This return survey was made not only to obtain specimens of various grasses and other late-flowering taxa such as Solidago and Brickellia, but also to assess any changes due to the unusual amount of precipitation during July and August.

The spring drought broke during the July session with rains of 1 1/2 and 2 1/2 inches falling. These were typical summer cloudbursts. Within 36 hours after the first rain, one could detect a definite greening of the grassland on both rims of the canyon. Rainfall continued at an extraordinary rate and by September 17, when Martin and Fletcher returned, between 25 and 30 inches of rain reportedly had fallen. The change in the area was remarkable, appearing as though the entire area had been under irrigation.

It is unfortunate that only two days were available for collections. The severity of the drought coupled with the overabundance of precipitation provided a unique opportunity to measure recovery rates of the various species, especially grasses.

On sandier sites of the main canyon bottom and even on many of the side slopes, Bouteloua gracilis was more than knee high where, in July, the grass was so short that cows could no longer graze effectively. On tighter soils of the grassland beyond the canyon rims, B. gracilis fared less well. Seed heads were produced but were not abundant and while basal leaves often grew to several inches in height, vigor was much lower than on sandier soils. Most of the seed heads in the patches of B. gracilis were those of Bouteloua hirsuta. This less productive and less palatable grass recovered more readily than did B. gracilis.

Narrow canyons contained Sorghastrum nutans plants 5-6 ft tall, also Muhlenbergia rigens was common. Neither grass was much in evidence in July.

Weedy species responded equally well. One sand spot which, in July, was little more than a dune, now contained stands of Helianthus petiolaris shoulder high. In other areas, Chenopodium album was as much as 5 ft tall and in general the growth of other weeds was fully waist high.

As expected, the river bottom had less vegetation than in July due to scouring by recent floods. However, in the rocky interspace between the streamside stands of Tamarisk pentandra and the floodplain, those spots that had not been flooded frequently contained waist-high stands of Bouteloua curtipendula. On the floodplain above the river, Muhlenbergia torreyi was only slightly less than knee high.

Only selected areas of those surveyed in July were again sampled in September but 64 taxa not noted in July were added to the species list. These appear as a separate list for comparison purposes. Differences between spring and fall floras require further study. It is hoped that subsequent study can be arranged to look further into these differences from the point of view of geographic relationships, in regard to the origin of this particular flora as a whole, and in regard to the origin of specific taxa.

This field survey not only provided a wealth of data useful as baseline information but also has added much needed information on what was recently believed to be an exceedingly rare species, Astragalus wittmanii.

The annotated species list, including common names and distribution data, while not all inclusive, allows inferences about relationships between taxa and serves as an indication of relative frequency useful in any future monitoring.

Little was previously known about the flora of this area of New Mexico and, purely from the standpoint of herbarium additions, the 1000 plus specimens collected have added considerably to our knowledge of the Canadian River Canyon and have made the effort worthwhile.

Checklist of Fauna Noted During Botanical Field Trip
 Canadian River--Mills Canyon
 Kiowa Grasslands

Birds (June 29-July 5, 1981)

Turkey vulture	Horned lark
Marsh hawk	Barn swallow
Red-tailed hawk	Cliff swallow
Swainson's hawk	Violet-green swallow
Prairie falcon	Scrub jay
American kestrel	Common raven
Scaled quail	White-necked raven
American avocet	Bewick's raven
Killdeer	Rock wren
Mourning dove	Mockingbird
Roadrunner	Robin
Common nighthawk	Loggerhead shrike
White-throated swift	Yellow-breasted chat
Belted kingfisher	Wilson's warbler
Red-shafted flicker	Eastern meadowlark
Ladder-backed woodpecker	Northern (Bullock's) oriole
Lewis' woodpecker	Hepatic tanager
Hairy woodpecker	Blue grosbeak
Western kingbird	Indigo bunting
Cassin's kingbird	Lazuli bunting
Ash-throated flycatcher	Rufous-sided towhee
Black phoebe	Brown towhee
Say's phoebe	Lark sparrow
Western wood pewee	

Mammals (June 29-July 5, 1981)

Pallid bat	Gray fox
Eastern cottontail	Raccoon
Black-tailed jackrabbit	Mountain lion
Colorado chipmunk	Bobcat
Thirteen-lined ground squirrel	Mule deer

Mammals, Cont. (June 29-July 5, 1981)

Rock squirrel	Pronghorn antelope
Black-tailed prairie dog	Barbary sheep
Coyote	Ibex

Reptiles and Amphibians (June 29-July 5, 1981)

Great Plains toad	Eastern fence lizard
Red-spotted toad	Short-horned lizard
Woodhouse's toad	Skink
Leopard frog	Whiptail
Ornate box turtle	Black-necked garter snake
Lesser earless lizard	Prairie rattlesnake
Collared lizard	Western diamondback rattlesnake

Birds (September 17,18, 1981)

Turkey vulture	Pinyon jay
Marsh hawk	Common bushtit
Swainson's hawk	House wren
Great horned owl	Solitary vireo
Red-shafted flicker	Black-throated gray warbler
Lewis' woodpecker	Wilson's warbler
Williamson's sapsucker	Hepatic tanager
Cassin's kingbird	Pine grosbeak
Western wood pewee	Pine siskin
Horned lark	Vesper sparrow
Scrub jay	Lincoln's sparrow

On both trips, magpies were sighted commonly in Springer but were not noted in the study area 15 miles to the south.

Mammals (September 17,18, 1981)

Black bear	Badger
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Astragalus wittmannii Barneby

Astragalus wittmannii is a low-growing milkvetch; it was first described by Rupert C. Barneby in 1979. The first collections were made in June of that year near the Levy exit off I-25, north of Wagon Mound.

The Federal Register of December 15, 1980 listed A. wittmannii as a Category I species. These are species for which the U. S. Fish and Wildlife Service "has sufficient information on hand to support the biological appropriateness of their being listed as Endangered or Threatened species."

Sufficient information concerning this plant was collected during the July field trip to recommend that it be removed from consideration for listing as a Federally Threatened or Endangered species.

Spellenberg, Soreng, and Ward, of the NMSU contingent, collected A. wittmannii first on their way into the Mills Canyon Campground. The collection was made from a broken limestone knoll at about 6000 ft elevation and some two miles west of Mills (Sec. 3, T21N, R25E).

Subsequent investigations by various of the field participants revealed the nine population locations encircled on the accompanying map.

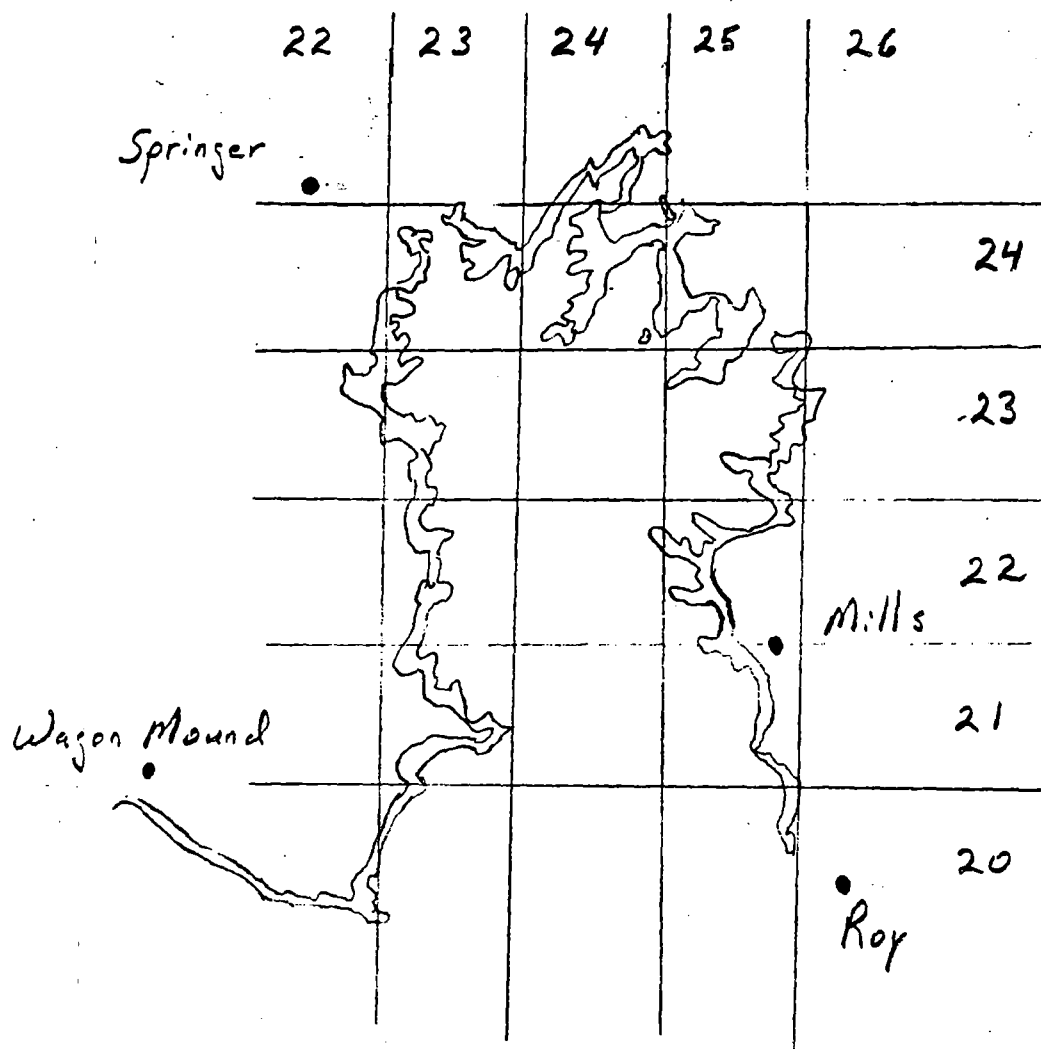
Astragalus wittmannii apparently is best adapted to outcrops of the Greenhorn formation, a thin limestone layer of Cretaceous age. A map is provided that roughly outlines this formation in the Mills area. All limestone knolls of the Greenhorn formation searched in the Mills area were found to contain populations of A. wittmannii.

Although the largest population checked contained only about 200 individuals or rather clumps of individuals, the ease with which we were able to extend the range of this taxon along this formation attests to the relative abundance of A. wittmannii locally.

During the course of our investigations we drew various conclusions regarding the rarity and probable status of this

species and, as we found more suitable habitat and greater numbers of individuals, we ultimately discarded any notion of supporting a recommendation for Federal protection. Astragalus wittmannii is a local endemic to be sure; however, we found no factor adversely affecting the continued existence of this taxon. Apparently, the recent discovery and perceived rarity of this species are due to the botanically unexplored nature of this part of the state.

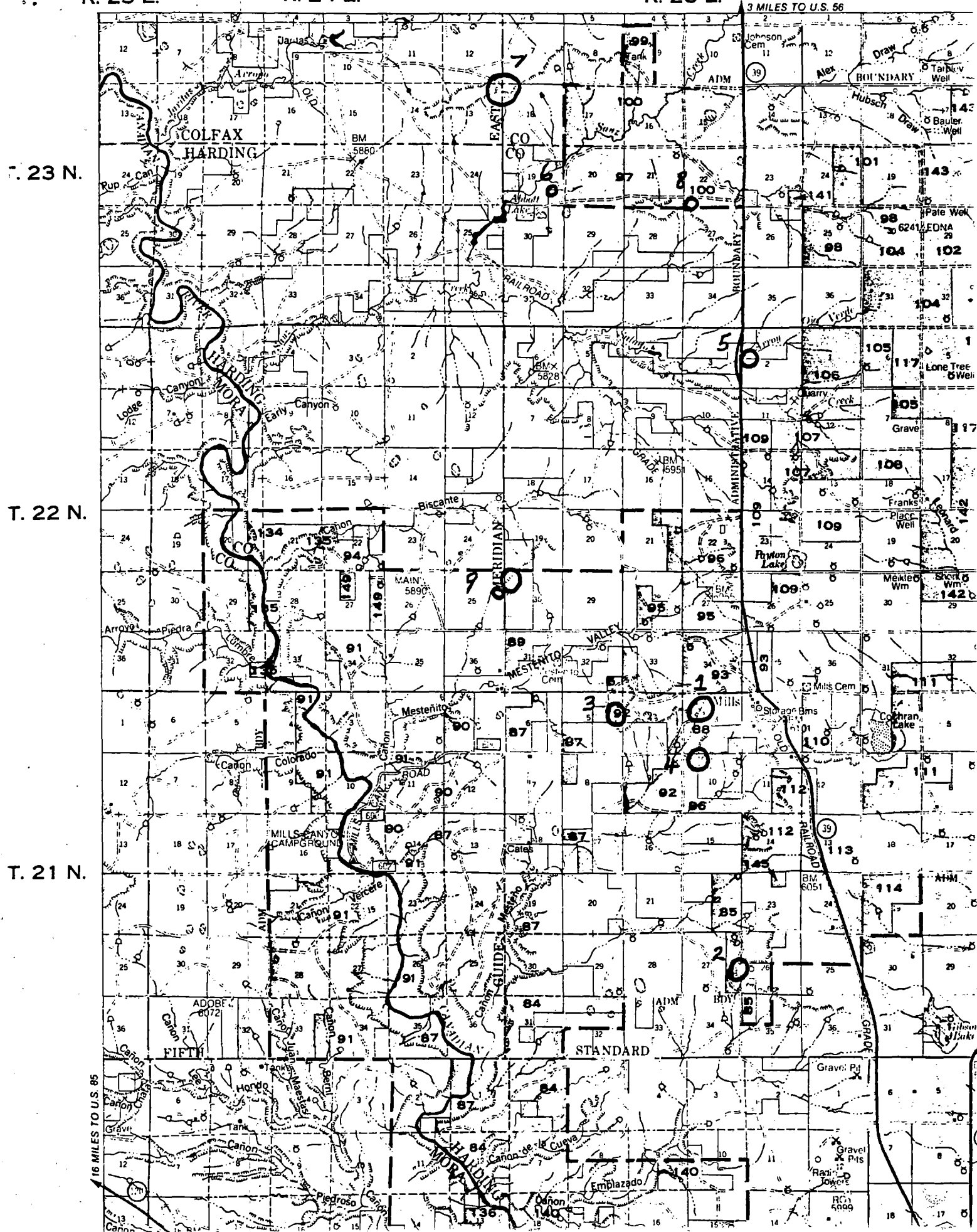
Astragalus wittmannii should be retained, at least temporarily, on the Southwestern Region sensitive species list and further field investigations into the distribution of this plant should continue during the spring flowering period.



Greenhorn limestone outcrops East
and West of the Canadian River

73

R. 25 E.



Astragalus cremnophylax

Brittonia, 31(4), 1979, pp. 459-463.

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DRAGMA HIPPOMANICUM IV. NEW TAXA OF ASTRAGALUS SECT. HUMILLIMI

RUPERT C. BARNEBY

Barneby, Rupert C. (New York Botanical Garden, Bronx, NY 10458). *Dragma Hippomaniacum* IV. New taxa of *Astragalus* sect. *Humillimi*. *Brittonia* 31: 459-463. 1979.—*Astragalus wittmannii*, from northern New Mexico, representing a new subsection *Nothorophaca*, and *A. cremnophylax* var. *myriorrhaphis*, from northwestern Arizona, are described, figured and discussed.

Astragalus wittmannii Barneby, sp. nov. (Fig. 1)

Statura caespitosa, pube dolabriformi necnon legumine minuto 1-loculari cum sect. *Humillimis* Barneby congrua, sed ab ea floribus solitariis axillari-radicalibus arcte sessilibus, calycis tubo cylindrico, foliis eximie dimorphis synanthiis brevissimis 3-5-foliolatis, hysteroanthiis elongatis 5-7-foliolatis basi stipulis breviter inter se contra petiolum connatis suffultis, necnon legumine subgloboso-pyriformi nullimodo compresso valde diversa, iisdem notis subsect. *Nothorophacae* Barneby, subsect. nov., constituens; a sect. *Orophaca* (A. Gray) Coult. & Nels. quoad habitum pubemque comparabili imprimis foliis pinnatis (nec palmatis 3-foliolatis), stipulis haud hyalinis, leguminisque forma remotior.

TYPE: UNITED STATES. NEW MEXICO. Mora Co.: near mile 395.5 on Interstate Highway 25 near the Levy exit N of Wagon Mound, 1985 m, 9 Jun 1979 (fruct.), Barry Johnston & Ron Wittmann 2005 (HOLOTYPE: NY; ISOTYPE: COLO). Ibid., from the same plant, 21 Apr 1979 (flor.), Ron Wittmann 256 (PARATYPES: COLO, NY).

Diminutive, densely caespitose perennial herbs with woody taproot and repeatedly forking caudex thatched with recurving marcescent petioles, forming depressed cushions of foliage up to 3 dm diam, in habit seasonally dimorphic, at vernal anthesis acaulescent, the short 3-5-foliolate leaves then not surpassing the solitary sessile radical flowers, the stems lengthening after anthesis and becoming 1.5-3 cm, composed of 3-5 developed internodes each bearing a much longer 5-7-foliolate leaf with filiform petiole, the foliage at all stages of growth silvery-strigulose with dolabriform hairs up to 0.5-0.7 mm, the pods remaining sessile at base of the mature stems. *Stipules* membranous pallid dimorphic, the vernal ones imbricated ovate-triangular ± 2 mm, almost fully amplexicaul but free, those subtending hysteroanthous leaves lanceolate 3-5 mm, fully amplexicaul and shortly connate opposite the petiole. *Leaves* dimorphic: (a) synanthous radical $\pm 7-13$ mm, the petiole not over 1 cm, the 3 palmate or 5 subpalmate leaflets oblanceolate obtuse 2-4 mm; and (b) hysteroanthous cauline 2-6 cm, pinnately 5-7-foliolate, the erect petiole 2-4 cm, the rachis 3-16 mm, the leaflets linear-oblanceolate or -elliptic acute (5)6-12 mm. *Peduncles* obsolete 1-flowered, the erect flower itself sessile, subtended by an ovate submembranous bract ± 2.5 mm; bracteoles 0. *Calyx* 8-10 mm, the subsymmetric disc 0.7 mm deep, the cylindric tube 6-6.7 \times 2-2.5 mm, the linear-subulate subequal teeth 2-3.3 mm, the whole marcescent but ruptured by the pod. *Petals* glabrous, purple beyond the pale claws and drying violet, the almost erect, broadly oblanceolate truncate-emarginate banner 14-16.5 \times 6 mm; wings 14.5-17 mm, the claw 7.6-10.5 mm, the oblong-oblanceolate obtuse blade 7.2-7.5 \times 1.8-2.1 mm; keel 11-13 mm, the claws 7-9 mm, the lunately half-elliptic blade $\pm 4.6 \times 1.9$ mm, incurved through $\pm 45^\circ$ to

BRITTONIA 31: 459-463. October-December, 1979.

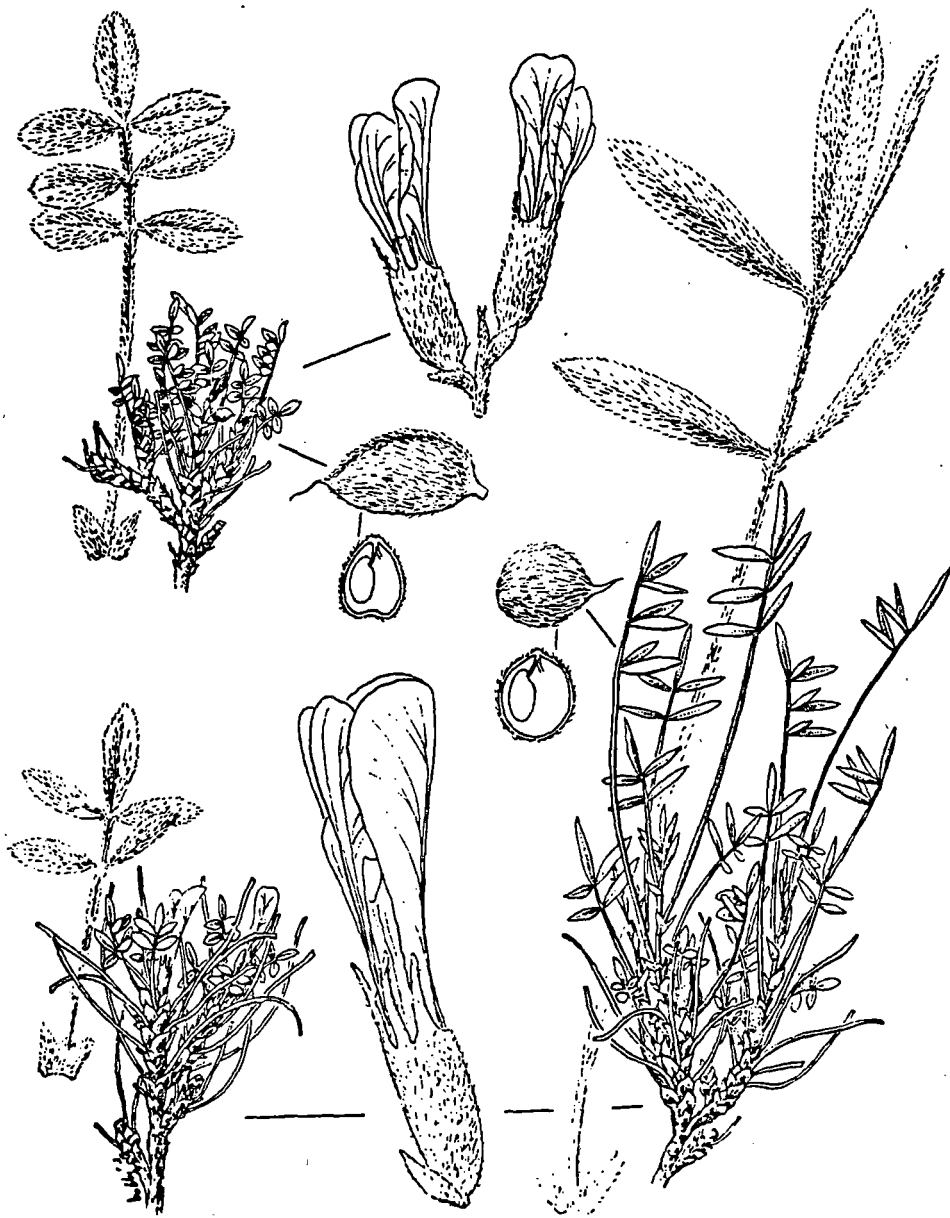


FIG. 1. *Astragalus siliceus* Barneby, upper left (from Spellenberg 4639, fl, and 2059, fr) and *A. wittmannii* Barneby, right and bottom (from Wittmann 256, fl, and Johnston & Wittmann 2005, fr). Habit, $\times 1$; detached leaves, flowers and pods with transverse section, $\times 4$.

the obtuse apex. Anthers 0.6–0.7 mm. Ovary strigulose. Pod strictly sessile, inversely plumply pyriform, the almost globose body 3 mm diam abruptly contracted into an erect subulate beak ± 1.5 mm, the sutures equally convex, scarcely prominent, the firm green valves neither depressed nor sulcate, not inflexed;

dehiscence not seen; ovules 7-8; seeds obliquely reniform $\pm 1.9 \times 1.5$ mm, the testa smooth lustrous brown purple-speckled.

The discovery in 1955, on the Rio Grande-Pecos divide in Torrance County, New Mexico, of *Astragalus siliceus* Barneby, a pulviniform plant resembling some Andean species related to *A. minimus* Vog., was a gratifying surprise; that northern New Mexico should now yield another, apparently related but extremely distinct species goes beyond all expectations. *Astragalus wittmannii* is habitally similar to *A. siliceus* (Fig. 1), but differs in extreme seasonal dimorphism of the leaves, reduction of the raceme to a solitary flower borne sessile in the leaf-axil, a cylindric calyx and correspondingly narrow petals, an erect banner and a globular pod neither laterally compressed nor ventrally carinate, but contracted at the apex into a little subulate beak. At anthesis, when only the short, relatively simple early leaves are present, it suggests some member of sect. *Orophaca*, but has more technical characters in common with sect. *Humillimi* than with any described American group within the genus. Development of truly caulescent stems beyond the spent flowers, two or three pairs of leaflets in most leaves, and small sub-membranous but not sheathing and hyaline stipules exclude *A. wittmannii* from *Orophaca*, an allopatric group extending southward over the High Plains no further than northeastern Colorado and adjoining Kansas. On the other hand it is only awkwardly inserted in sect. *Humillimi* as originally defined (Barneby, R. C. Atlas of North American *Astragalus*. Mem. New York Bot. Gard. 13: 1000. 1964), the sessile uniflorous raceme and cylindric calyx-tube being anomalous or new characters for the section. The strongly dimorphic foliage, as described above, is perhaps more nearly reminiscent of sect. *Orophaca* (e.g. of *A. gilviflorus* Sheld.) than of sect. *Humillimi* as known hitherto, but a similar even though less emphatic dimorphism is a feature of the new *A. cremnophylax* var. *myriorrhaphis* (see below) and thereby becomes more easily accommodated in the concept of the section. Nonetheless, *A. wittmannii* is isolated even among the *Humillimi* by the syndrome of depauperate raceme, elongate flower, and globular pod which shows no sign of compression and it has therefore been referred in the foregoing diagnosis to a new subsection *Nothorophaca*. Because *A. wittmannii* is likely, for geographic reasons, to be compared with *A. siliceus*, they may be usefully distinguished as follows:

- | | |
|---|----------------------|
| 1 Peduncles 1.5-6 (11) mm, 1-3- (commonly 2)-flowered, the pedicels at least 1.5 mm; calyx-tube campanulate 3.2-4.2 mm, the teeth 0.6-2 mm; banner 9.5-11.5 mm, curved backward through $\pm 45^\circ$; keel $\pm 7.5-8.5$ mm, the blades incurved through 90° ; body of pod carinate ventrally by the suture, depressed dorsally; hysteroanthous leaves not markedly different from the early ones, not over 2 cm, and not borne on well developed stems produced beyond the flowering nodes; east-central Torrance County, New Mexico | <i>A. siliceus</i> |
| 1 Peduncles obsolete, the solitary flower sessile; calyx-tube cylindric 6.5-7 mm, the teeth ± 3.3 mm; banner ± 16.5 mm, erect or almost so; keel ± 13 mm, the blades incurved through $\pm 45^\circ$; body of pod globular, neither keeled nor depressed; hysteroanthous leaves 2-6 cm, borne on stems 1.5-3 cm produced beyond the fruiting nodes; western Mora County, New Mexico | <i>A. wittmannii</i> |

The collectors of *A. wittmannii* found what they took to be only a single plant, but I conclude that this must have been a cluster of individual ones, for two complete taproots are found among the type material. Dispersal of a tiny radical sessile pod is slow and uncertain, and seeds caught among clay-impacted caudex-branches may well germinate in situ to form a cushion of foliage supported by several independent root-systems. These plants were found on gray basalt used

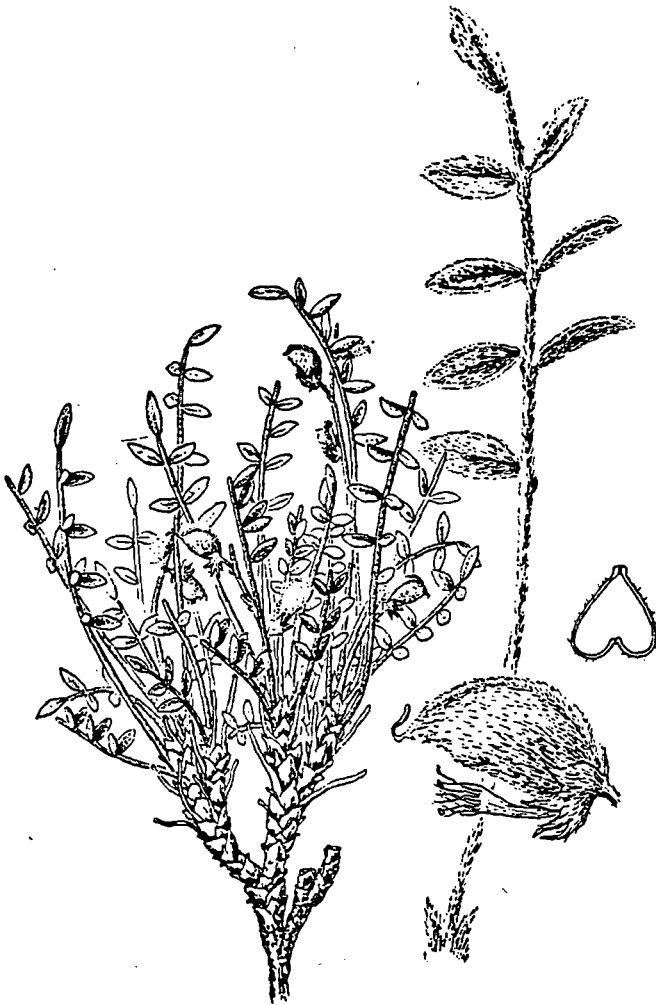


FIG. 2. *Astragalus cremnophylax* var. *myriorrhaphis* Barneby (from Holmgren, Holmgren & Barneby 9145). Habit, $\times 2$; detached leaf, pod and transverse section of pod, $\times 5$.

as a road-bank facing and despite a day's search in the vicinity and around the quarry from which the fill had been taken no others were discovered. I recall that at its type-locality in the Pedernales Hills, about 175 km south of Wagon Mound, *A. siliceus* appeared in the first instance almost equally rare and localized, but Dr. Richard Spellenberg has since located around Encino and Negra, within a circumference of about 25 km, several populations of the species (Spellenberg 2059, 4639, 4640, 4641, all NMC, NY), one estimated to contain up to 10,000 plants, and we can only hope that *A. wittmannii* will be found elsewhere in similar abundance.

The species is named in honor of the collector and discoverer, Ron Wittmann. I am most grateful to Drs. William A. Weber and Barry Johnston for a generous share of the type-collections.

Range Extensions

The lack of intensive collecting in this part of the state is evidenced by the number of taxa the group collected which represent extensions of their range within the state.

Our species list was checked against the distribution maps in Martin and Hutchin's A Flora of New Mexico. A range extension was considered to be a taxa that had at least one county between our collections and the nearest reported collection.

Some of the more notable extensions are: **Alisma subcordatum*, *Apocynum cannabinum* var. *glaberrimum*, *Asclepias macrotis*, *Baccharis pternoides*, *Berula erecta*, *Brickellia floribunda*, *Carex xerantica*, **Celtis occidentalis*, *Chrysopsis viscida*, *Cryptantha minima*, *Cyperus aristatus*, **Draba brachycarpa*, *Epipactis gigantea*, *Eupatorium wrightii*, *Euphorbia micromeria*, *Heteranthera limosa*, **Ipomoea hederacea*, *Juglans microcarpa*, *Macromeria viridiflora*, *Morus microphylla*, *Muhlenbergia rigens*, **Myriophyllum pinnatum*, *Oxybaphus albidus*, **Petalostemum multiflorum*, *Pityrogramma triangularis*, *Polygonum incarnatum*, *Potamogeton diversifolius*, *Quercus grisea*, *Quercus pungens*, *Quercus rugosa*, *Scirpus acutus*, *Setaria lutescens*, *Streptanthella longirostris*, *Thelesperma longipes*, *Thelesperma subnudum*, *Tradescantia pinetorum*, *Typha angustifolia*, and *Vicia ludoviciana*.

Those taxa not recorded by Martin and Hutchins as occurring in New Mexico are marked with an asterisk.

Final Comments

As our work on this report neared completion, we learned of recommendations to the U. S. Fish and Wildlife Service to place Aster horridus on the Notice of Review as a species nominated for Federal protection. Previous collections of this distinctive plant, endemic to northeastern New Mexico, were few and little was known of it prior to this study.

The severe drought and the July collection time masked the frequency and abundance of this fall-flowering species during the summer session but in September Martin and Fletcher found the plant to be present and abundant in the small tributaries searched as well as along Route 600, dropping into the Canadian River Canyon, both in the grader ditch and on the steep north-facing slopes adjacent to the road. While this ~~center~~ may be the center of its distribution, suitable habitat abounds, much of which is relatively inaccessible.

Additional information should be collected on this species as it should for several others within the study area. Two of these are Yucca neomexicana and a Senecio which we tentatively labeled Senecio canus. However, we have found no indication that Aster horridus merits or necessitates Federal protection as either Endangered or Threatened.



Reply to: 2670 Threatened and Endangered Plants and Animals

Date: November 23, 1981

Subject: Canadian River Floristic Survey

To: Forest Supervisor, Cibola National Forest

Enclosed is a copy of the Canadian River floristic survey compiled by Reggie Fletcher, Regional Botanist, Paul Knight, New Mexico Heritage Program, and William Martin, University of New Mexico.

Information in this report was gathered primarily during a July field excursion manned by 14 botanists volunteering their services in order to obtain a more thorough understanding of a botanically little known portion of the state.

The survey has provided sufficient information on two plants being considered for protection as Federally Endangered or Threatened, Astragalus wittmannii and Aster horridus, to recommend their being removed from such consideration. Neither plant was known to occur within the study area prior to this survey.

A \$1,000 contract funded through wildlife provided mileage and board monies for the field excursion; however, considering the time invested by each individual, the study was truly a volunteer effort.

We feel this study has been valuable, not only in providing baseline information on the study area useful to other botanists and land administrators, but in providing an avenue by which the participants would share their views and knowledge. This should be particularly useful in future rare plant studies.

Studies of this type, emphasizing volunteer work, can play an important role in these times of fiscal constraint. Not only the participants but several additional botanists have expressed a desire to participate in similar future investigations.

DON D. SEAMAN
Director of Range Management

Enclosure

1cc: WO (w/enc.)
Alton Bryant (w/enc.)
Wildlife (RO) (w/o enc.)



Flora of the Canadian River Canyon
Spring 1982 Additions to the Annotated Checklist

Boraginaceae

- **Cryptantha crassiseppala* var. *elachantha* D,M
- Lithospermum incisum* K

Cactaceae

- Echinocereus triglochidiatus* var. *melanacanthus* D

Compositae

- Artemisia frigida* M
- Baccharis wrightii* D
- Dyssodia papposa* L
- Erigeron divergens* D
- Erigeron nudiflorus* M
- Gutierrezia sarothrae* D
- **Hymenoxys acaulis* var. *acaulis* K,L
- Leucelene ericoides* D
- **Senecio plattensis* (*Astragalus wittmanii* site 4 miles NW Roy)

Cruciferae

- **Descurainia pinnata* ssp. *ochroleuca* E
- **Lesquerella montana* M
- Lesquerella ovalifolia* D
- Sisymbrium linearifolium* K

Cupressaceae

- **Juniperus scopulorum* x *J. virginiana*

Cyperaceae

- Eleocharis macrostachya* D

Geraniaceae

- Erodium cicutarium* M

Gramineae

- **Aristida glauca* D
- **Bromus commutatus* P
- **Enneapogon desvauxii* D
- **Festuca ovina*
- **Glyceria pauciflora* D
- **Muhlenbergia mundula* P
- Muhlenbergia pauciflora* D
- **Muhlenbergia porteri* D
- **Panicum scribnerianum* P
- **Poa bigelovii* P
- **Poa fendleriana* P
- **Poa glaucifolia* P
- **Poa palustris* P

**Poa secunda* P
**Stipa comata* D
 Stipa neomexicana D
**Tridens elongatus* D
 Tridens pilosus D

Leguminosae

Amorpha canescens D
**Astragalus bisculatus* K
**Astragalus mollissimus* K
**Astragalus nuttallianus* var. *austrinus* E
 Dalea formosa D
 Dalea jamesii M
 Lupinus kingii D
 Oxytropis lambertii var. *bigelovii* K
**Vicia americana* var. *linearis* E
 Vicia ludoviciana D

Linaceae

**Linum puberulum* K

Malvaceae

Sphaeralcea coccinea var. *coccinea* D

Onagraceae

**Oenothera albicaulis* D
**Oenothera flava* D,L

Plantaginaceae

**Plantago argyraea* D
 Plantago purshii var. *purshii* D

Rosaceae

Cercocarpus montanus D
 Prunus virginiana var. *melanocarpa* E (vice *P. serotina* this location)

Salicaceae

Salix amygdaloides P

Scrophulariaceae

Castilleja integra D
**Castilleja sessiliflora* K
 Veronica peregrina var. *xalapensis* P

Solanaceae

**Chamaesaracha coronopus* D

Umbelliferae

**Cymopterus montanus* M

* Not previously noted in the flora, others are new locations but were previously cited as members of the flora.

Verbenaceae

Verbena bipinnatifida K

Canadian River Botanical Field Trip

May 17 - 19, 1982

Bird List

Mallard	pond	2
Turkey Vulture	P	2
Marsh Hawk	P	2
Red-tailed Hawk	A,P	2
Swainson's Hawk	P	1
Kestrel	R,P,A	common
Scaled Quail	P	
Mountain Plover	P	1
Killdeer	P	1
Long-billed Curlew	P	2
Mourning Dove	R,A	abundant
Roadrunner	G	1
nest with 3 young in a Juniper		
Burrowing Owl	P	1
Flammulated Owl	R	1
nest in cottonwood by the river		
Poorwill	R	2
Common Nighthawk	J	1
White-throated Swift	R,A	common
Hummingbird	A	1
(probably Broad-tailed), a female on a nest		
Belted Kingfisher	R	1
Common Flicker	A,R	3
Lewis' Woodpecker	A	common
Hairy Woodpecker	A	1 at probable nest
Western Kingbird	R,P,A,J	common
Cassin's Kingbird	R,P,A,J	abundant
Ash-throated Flycatcher	R	2
Eastern Phoebe	A	1 at probable nest
Say's Phoebe	R,A	2
nest in old Cliff Swallow nest		
Western Wood Pewee	A	common
Horned Lark	P	abundant
Barn Swallow	P	common, near bridges and houses
Cliff Swallow	P	common, cliffs near water
Violet-green Swallow	R,A	common

Scrub Jay	J, A	common
Common Raven	J, A, R, P	common
Plain Titmouse	J, A	3
Common Bushtit	J, A, R	common
Red-breasted Nuthatch	A	common
House Wren	A-J	1
Bewick's Wren	A-J	1
Rock Wren	R	1
Canyon Wren	A	1 in canyon
Mockingbird	R	common
American Robin	R, A	common
Water Pipit	P	1
Loggerhead Shrike	P	2
Warbling Vireo	A	1
Black-and-White Warbler	G	1
Yellow Warbler	R	1
Yellow-rumped Warbler	G	1
Grace's Warbler	G	1
Yellow-breasted Chat	R	common
Macgillivray's Warbler	R	1
Meadowlark (E. or W.?)	P	abundant
Brown-headed Cowbird	R	4
Northern Oriole (Bullock's)	R	2
Northern Oriole (Baltimore)	R	1
Blue Grosbeak	R	common
Indigo Bunting	R	common
Lazuli Bunting	R	1
House Finch	A, R	common
American Goldfinch	R	1
Lesser Goldfinch	R	2
Pine Siskin	A	1 flock of about 20
Green-tailed Towhee	R	1

Brown Towhee	R-J	3
Lark Bunting	P	abundant
Vesper Sparrow	P-J	
Lark Sparrow	P, R, J	abundant
Tree Sparrow	R-J	1
White-crowned Sparrow	R, J	common

Habitat designations:

- P - Short Grass Plains
- J - Pinyon-Juniper
- R - Riparian
- G - Ponderosa grove in Short Grass Plains
- A - Ponderosa and Aspen

A dash between symbols indicates a mosaic of both habitats.
Habitat designates where birds were seen, not necessarily where
they are most common.

Abundance designations:

Numbers are for birds sighted or heard.